APPLIED ANALYTIC MODELING

BA 706 FALL 2022

GROUP PROJECT

A FULL DATA MINING AND PREDICTIVE MODELING PROJECT AND REPORT ON 'EMPLOYEE TURNOVER DATASET'

(Gotten from kaggle.com)

IBUKUNOLUWA OLUKOKO-301259629

INTRODUCTION

Employee attrition happens when employees resign from a company at a rate higher than the company employs new hires. This can be a concern for a company as the cost implications from brain drain and reputational risk can become a challenge if this phenomenon is not checked.

We are assuming the problem statement is the high turnover of employees in different industries and our mission is to discover the reason for this high turnover rate and give recommendations on how to reduce the risk of losing good hands in the industries by reducing employee turnover.

Our data set, Employee Turnover (Kaggle.com) contains 16 variables and over 1000 observations. We will be predicting the variables that impact an employee's decision to resign from their place of employment.

The data was collected using questionnaires completed by the staff who quit. The employee database was also used to collate historical and present generic information about all employees.

There are several factors that could affect an employee's decision to leave their place of employment. Below is the dictionary showing the description of the variables we will be drawing our conclusions from in this project:

NAME	MODEL ROLE	MEASUREMENT LEVEL	DESCRIPTION
STAG	INPUT	INTERVAL	Experience(time) 0.39 - 179
EVENT	TARGET	BINARY	Employee turnover (0-NO or 1YES)
GENDER	INPUT	NOMINAL	Employee's gender (Female/Male)
AGE	INPUT	INTERVAL	Employee's Age
INDUSTRY	INPUT	NOMINAL	Employee's Industry
PROFESSION	INPUT	NOMINAL	Employee's profession
TRAFFIC	REJECTED	NOMINAL	From what pipeline did the employee come to the company (empjs, advert, rabrecNErab, youjs,referral,recNErab)
COACH	REJECTED	NOMINAL	Presence of training on probation (YES or NO)
HEAD_GENDER	INPUT	NOMINAL	Supervisor's gender (Female/Male)
GREYWAGE	INPUT	NOMINAL	Salary (White/Grey)
WAY	INPUT	NOMINAL	Employee's way of transportation

EXTRAVERSION	INPUT	INTERVAL	Extraversion score (1- 10)
INDEPEND	INPUT	INTERVAL	Independence score (1-10)
SELFCONTROL	INPUT	INTERVAL	Self -control score (1-10)
ANXIETY	INPUT	INTERVAL	Anxiety score (1-10)
NOVATOR	INPUT	INTERVAL	Innovator score (1-10)

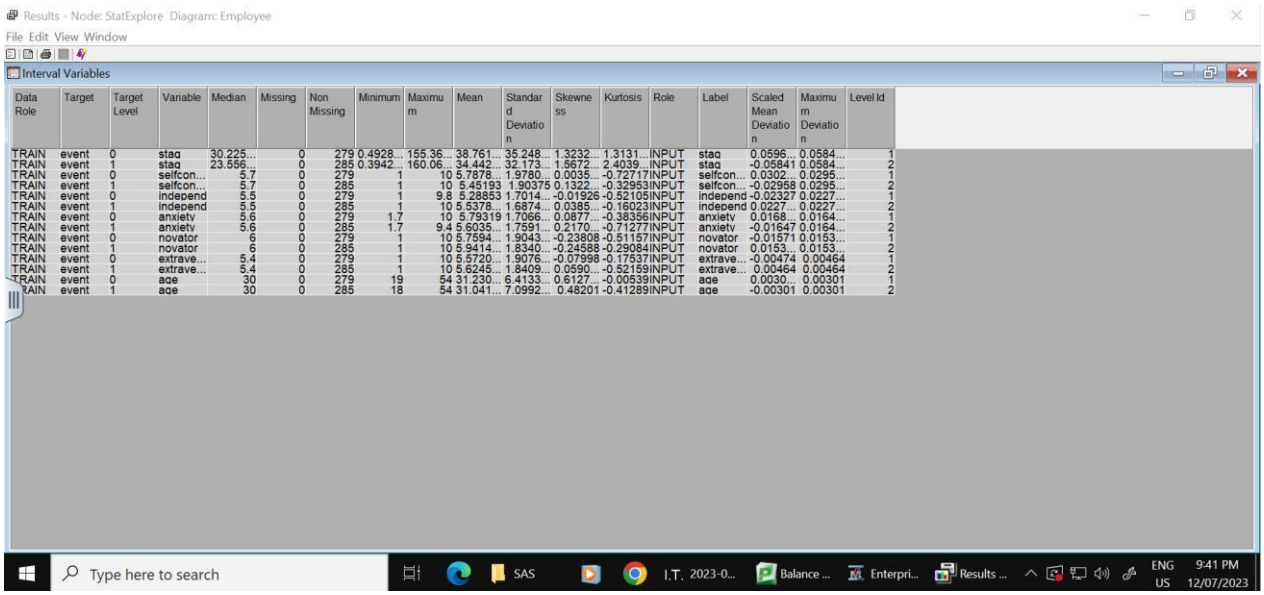
Description of the Traffic and Greywage variables

TRAFFIC	*This describes the means by which the employee learned of the vacancy in the company and how they applied. For example, direct recommendation by a friend who is an employee or through a job site to mention a few. As we have chosen to reject the variable, we will not dwell much on defining the terms.*
GREYWAGE	***Grey-wage**: in Russia or Ukraine means that the employer pays just a tiny bit amount of salary above the white-wage* ***White wage:** minimum wage*

DATA SETUP/EXPLORATION

We first imported the **employee dataset** and then made **'event'** our target variable as it is a binary variable indicating whether an employee resigned from the company.

We rejected **'traffic'** and **'coach'** because by narrowing down the scope of your analysis to factors directly tied to the workplace and job-related aspects, we can generate more actionable insights. Understanding why employees leave or stay within an organization is crucial for implementing effective retention strategies. By focusing on variables within the organization's control.

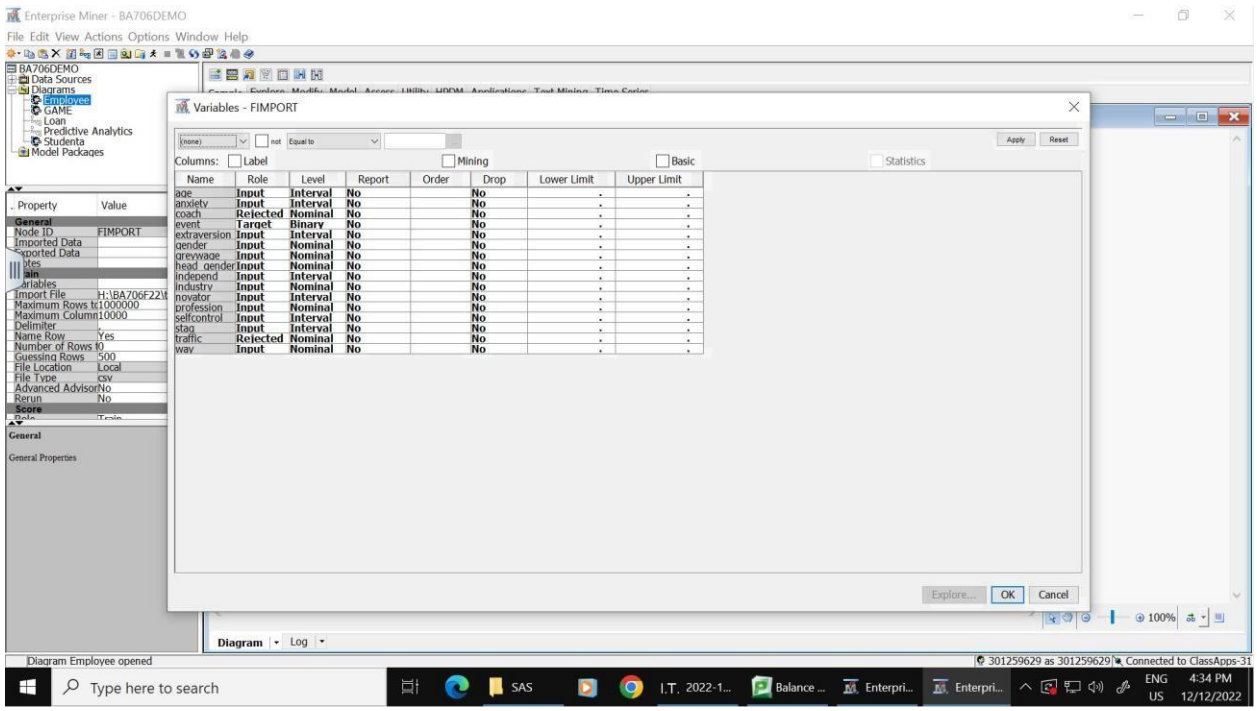


In the initial phase of statistical exploration we undertook a thorough examination of the dataset which yielded remarkable results - no missing values were observed across any variables considered. This attribute bolsters reliability and robustness for subsequent analysis since all available data is comprehensive enough to derive meaningful insights.

Furthermore an initial assessment determined that there was only minimal skewness present in the distribution. Skewness indicates asymmetry in the distribution with positive skewness suggesting a longer tail on the right side. In this particular case the observed skewness hinted at a minor deviation from perfect symmetry.

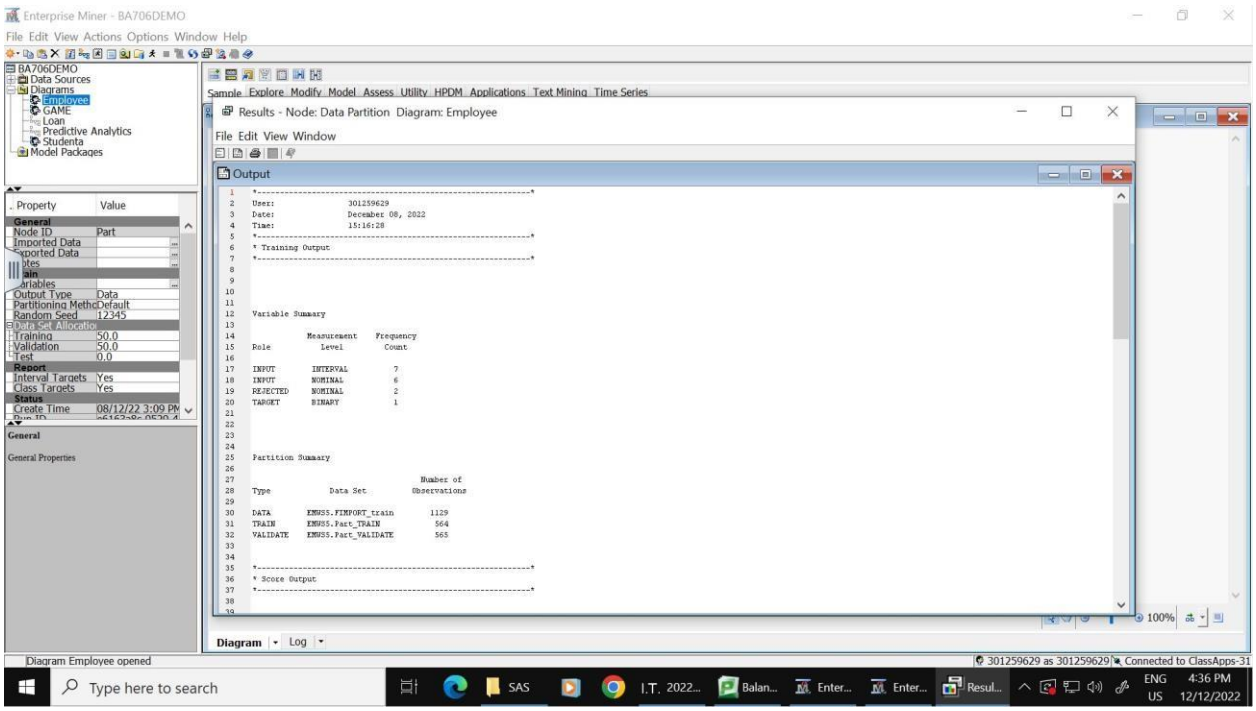
Although this skewness may have minimal impact on our current analysis. It is important to acknowledge its presence and make plans to address it during future stages of the project. Proper techniques for handling skewed data, such as logarithmic or power transformations, or utilizing specific statistical models catered to skewed distributions should be considered.

By recognizing and planning to address this slight skewness in subsequent stages of analysis we can ensure a more comprehensive and rigorous examination. Attending to these details will help guarantee accuracy in our results while fostering a deeper understanding of the factors contributing to employee attrition within our organization.



A data partition node was connected to the dataset with the below allocations:

Data Partition	Allocation	# of observations
Training	50%	564
Validation	50%	565
Test	0	0



DECISION TREES

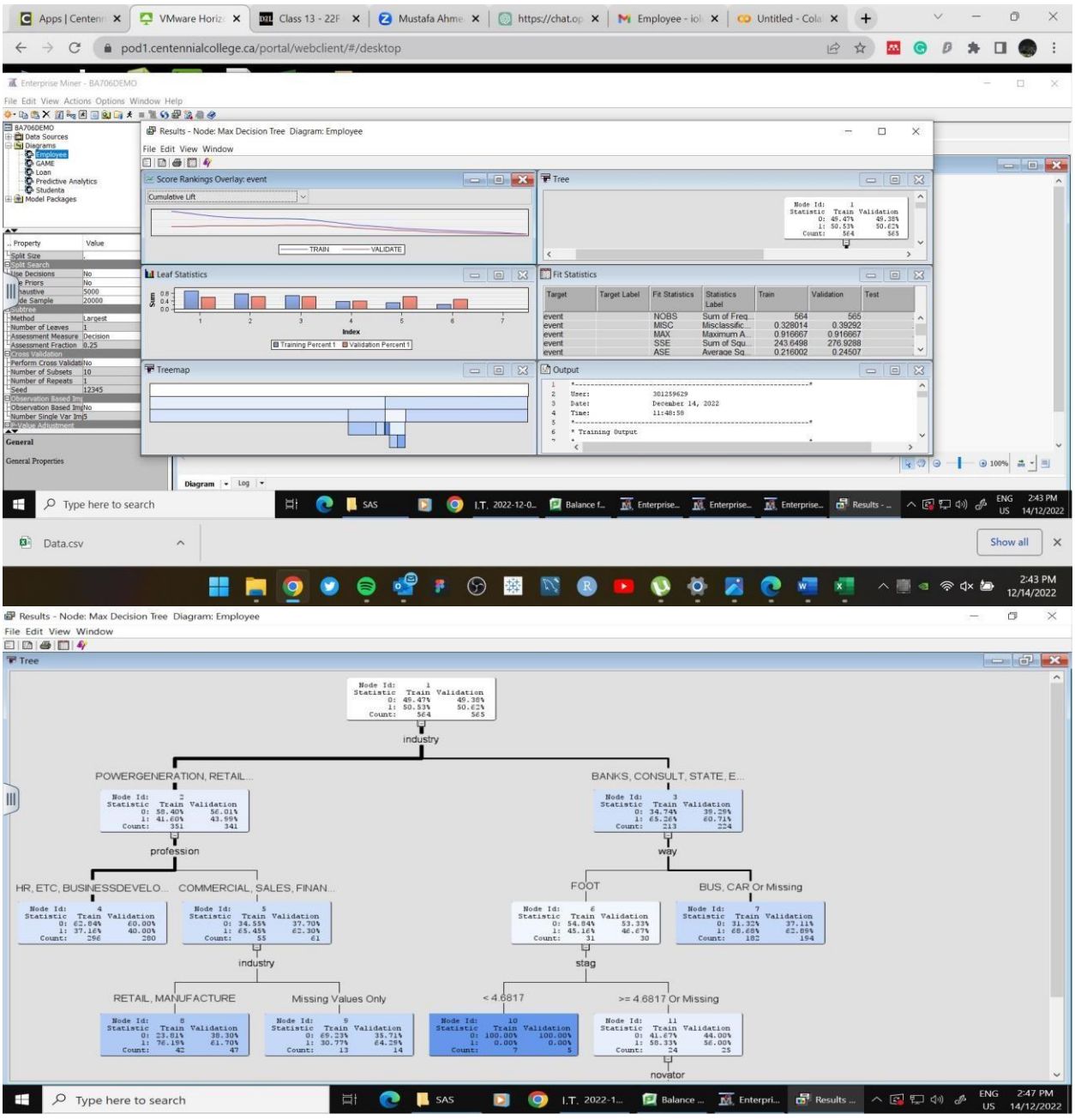
The first set of models we used are decision trees. The trees are classified based on the method used , the number of branches, and the assessment measure. The following tree models were built:

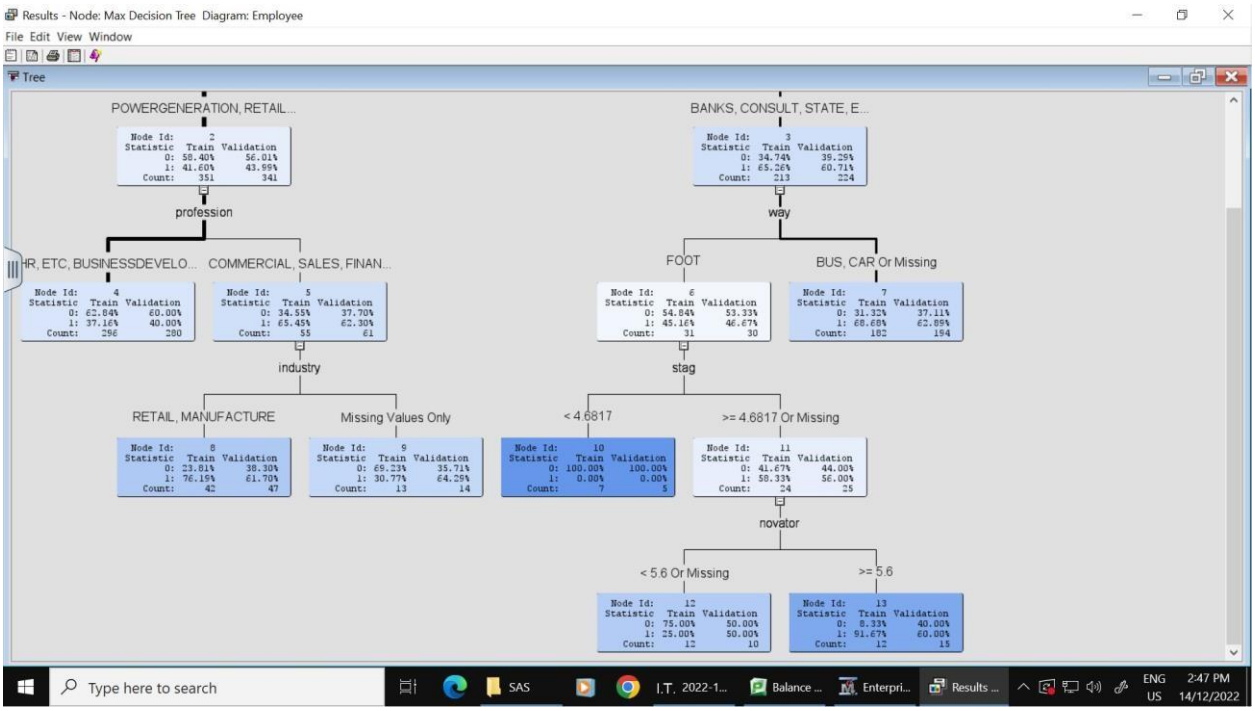
1. Maximal Trees(Two and Three Branch)

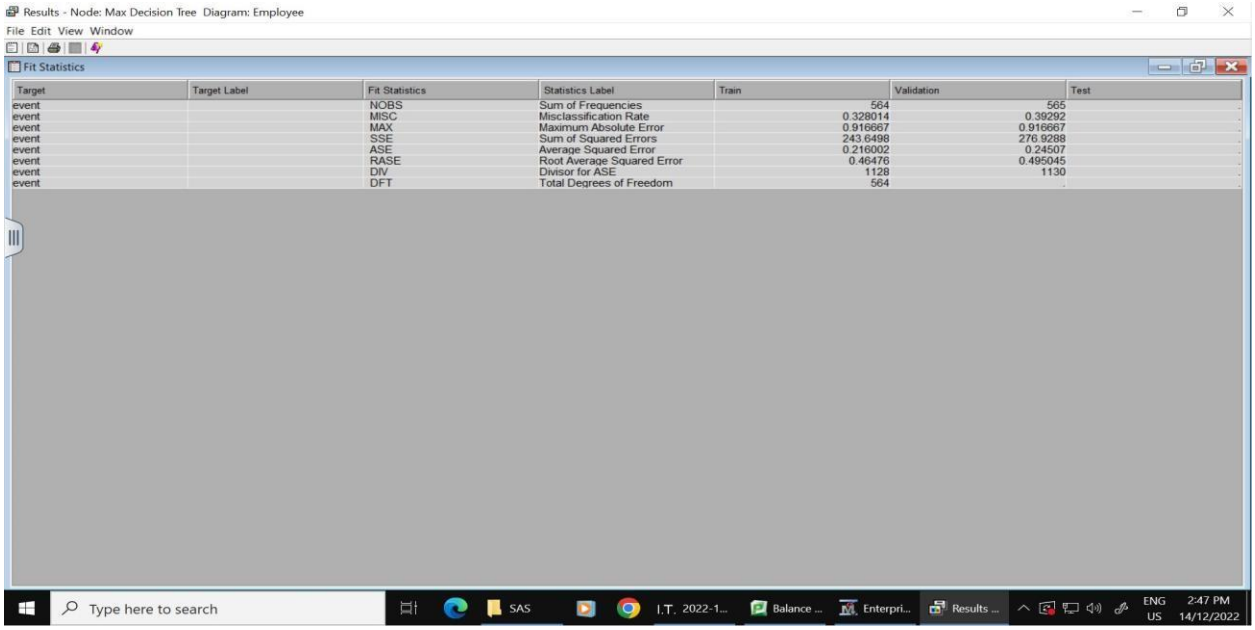
2. Classification Trees(Two and Three Branch) 3. Probability Trees(Two and Three Branch)

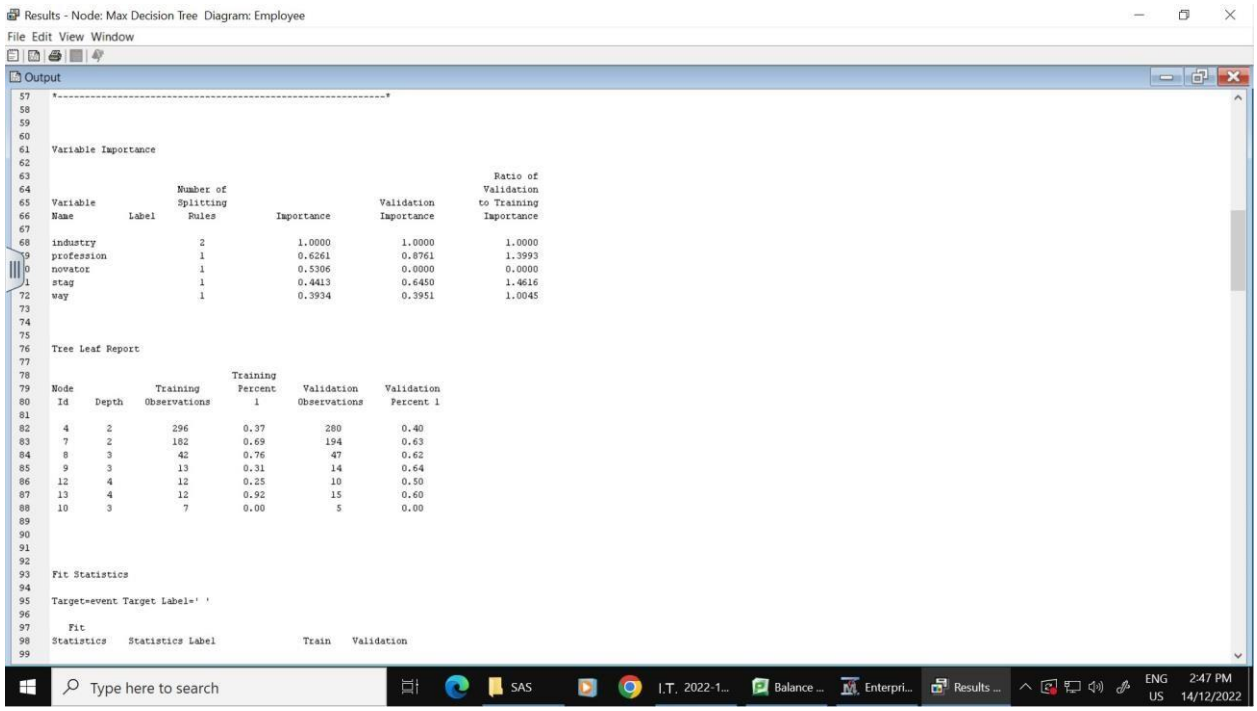
TWO-BRANCH MAXIMAL TREE

The decision tree node was attached to the data partition node with a maximum of two branches indicated, ‘largest’ used as the method and ‘decision’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.


Apps | Centenn
VMware Horiz
Class 13 - 22F
Mustafa Ahme
https://chat.op
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
Results - Node: Max Decision Tree Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
TRAIN
VALIDATE
Tree
Leaf Statistics
Training Percent 1
Validation Percent 1
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event NOBS Sum of Freq... 564 565
event MISC Misclassific... 0.328014 0.39292
event MAX Maximum A... 0.916667 0.916667
event SSE Sum of Squ... 243.6498 276.9288
event ASE Average Sq... 0.216002 0.24507
Treemap
Output
User: 301259629
Date: December 14, 2022
Time: 11:48:58
* Training Output
Type here to search
Data.csv
Show all
2:43 PM
12/14/2022
Results - Node: Max Decision Tree Diagram: Employee
File Edit View Window
Tree
Node Id: 1
Statistic Train Validation
0: 45.47% 49.38%
1: 50.53% 50.62%
Count: 564 565
industry
POWERGENERATION, RETAIL...
Node Id: 2
Statistic Train Validation
0: 58.40% 56.01%
1: 41.60% 43.99%
Count: 351 341
profession
BANKS, CONSULT, STATE, E...
Node Id: 3
Statistic Train Validation
0: 34.74% 39.25%
1: 65.26% 60.71%
Count: 213 224
way
HR, ETC, BUSINESSDEVELO...
Node Id: 4
Statistic Train Validation
0: 62.84% 60.00%
1: 37.16% 40.00%
Count: 296 280
COMMERCIAL, SALES, FINAN...
Node Id: 5
Statistic Train Validation
0: 34.55% 37.70%
1: 65.45% 62.30%
Count: 55 61
industry
FOOT
Node Id: 6
Statistic Train Validation
0: 54.84% 53.33%
1: 45.16% 46.67%
Count: 31 30
stag
BUS, CAR Or Missing
Node Id: 7
Statistic Train Validation
0: 31.32% 37.11%
1: 68.68% 62.89%
Count: 182 194
RETAIL, MANUFACTURE
Node Id: 8
Statistic Train Validation
0: 23.81% 38.30%
1: 76.19% 61.70%
Count: 42 47
Missing Values Only
Node Id: 9
Statistic Train Validation
0: 69.23% 35.71%
1: 30.77% 64.29%
Count: 13 14
< 4.6817
Node Id: 10
Statistic Train Validation
0: 100.00% 100.00%
1: 0.00% 0.00%
Count: 7 5
>= 4.6817 Or Missing
Node Id: 11
Statistic Train Validation
0: 41.67% 44.00%
1: 58.33% 56.00%
Count: 24 25
novator
Type here to search
2:47 PM
12/14/2022


Results - Node: Max Decision Tree Diagram: Employee
File Edit View Window
Tree
POWERGENERATION, RETAIL...
Node Id: 2
Statistic Train Validation
0: 58.40% 56.01%
1: 41.60% 43.99%
Count: 351 341
profession
HR, ETC, BUSINESSDEVELO...
Node Id: 4
Statistic Train Validation
0: 62.84% 60.00%
1: 37.16% 40.00%
Count: 298 280
COMMERCIAL, SALES, FINAN...
Node Id: 5
Statistic Train Validation
0: 34.55% 37.70%
1: 65.45% 62.30%
Count: 55 61
industry
RETAIL, MANUFACTURE
Node Id: 8
Statistic Train Validation
0: 23.81% 38.30%
1: 76.19% 61.70%
Count: 42 47
Missing Values Only
Node Id: 9
Statistic Train Validation
0: 69.23% 35.71%
1: 30.77% 64.29%
Count: 13 14
BANKS, CONSULT, STATE, E...
Node Id: 3
Statistic Train Validation
0: 34.74% 39.29%
1: 65.26% 60.71%
Count: 213 224
way
FOOT
Node Id: 6
Statistic Train Validation
0: 54.84% 53.33%
1: 45.16% 46.67%
Count: 31 30
stag
< 4.6817
Node Id: 10
Statistic Train Validation
0: 100.00% 100.00%
1: 0.00% 0.00%
Count: 7 5
>= 4.6817 Or Missing
Node Id: 11
Statistic Train Validation
0: 41.67% 44.00%
1: 58.33% 56.00%
Count: 24 25
novator
< 5.6 Or Missing
Node Id: 12
Statistic Train Validation
0: 75.00% 50.00%
1: 25.00% 50.00%
Count: 12 10
>= 5.6
Node Id: 13
Statistic Train Validation
0: 8.33% 40.00%
1: 91.67% 60.00%
Count: 12 15
BUS, CAR Or Missing
Node Id: 7
Statistic Train Validation
0: 31.32% 37.11%
1: 68.68% 62.89%
Count: 182 194
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
2:47 PM
14/12/2022


Results - Node: Max Decision Tree Diagram: Employee
File Edit View Window
Fit Statistics
Target | Target Label | Fit Statistics | Statistics Label | Train | Validation | Test
event | | NOBS | Sum of Frequencies | 564 | 565 |
event | | MISC | Misclassification Rate | 0.328014 | 0.39292 |
event | | MAX | Maximum Absolute Error | 0.916667 | 0.916667 |
event | | SSE | Sum of Squared Errors | 243.6498 | 276.9288 |
event | | ASE | Average Squared Error | 0.216002 | 0.24507 |
event | | RASE | Root Average Squared Error | 0.46476 | 0.495045 |
event | | DIV | Divisor for ASE | 1128 | 1130 |
event | | DFT | Total Degrees of Freedom | 564 | |
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
2:47 PM
14/12/2022

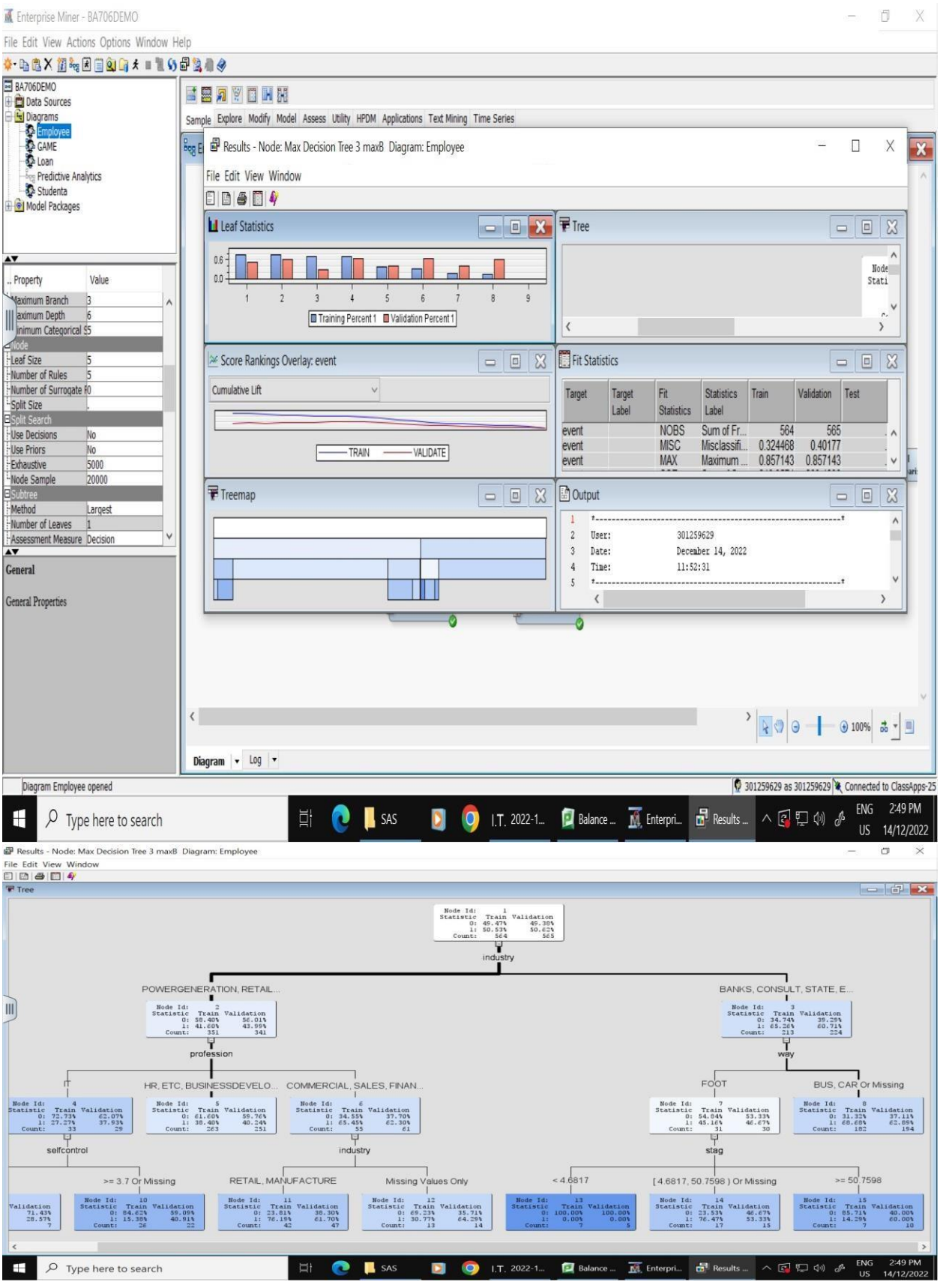


The tree had seven leaves with five variable splits. The first split occurs at the Industry variable with the highest logworth when compared to the other variables selected in the model. The tree shows that 62.89% of employees in Banks, Consult and State who go to work in vehicles are likely to quit their jobs. 60% of employees with innovator score of greater than 5.6 who have worked greater than 4.7 months in the Bank, Consult, and State industries are likely to quit. 62% of Commercial, Sales, and Finance professionals in the power generation industry are likely to quit.

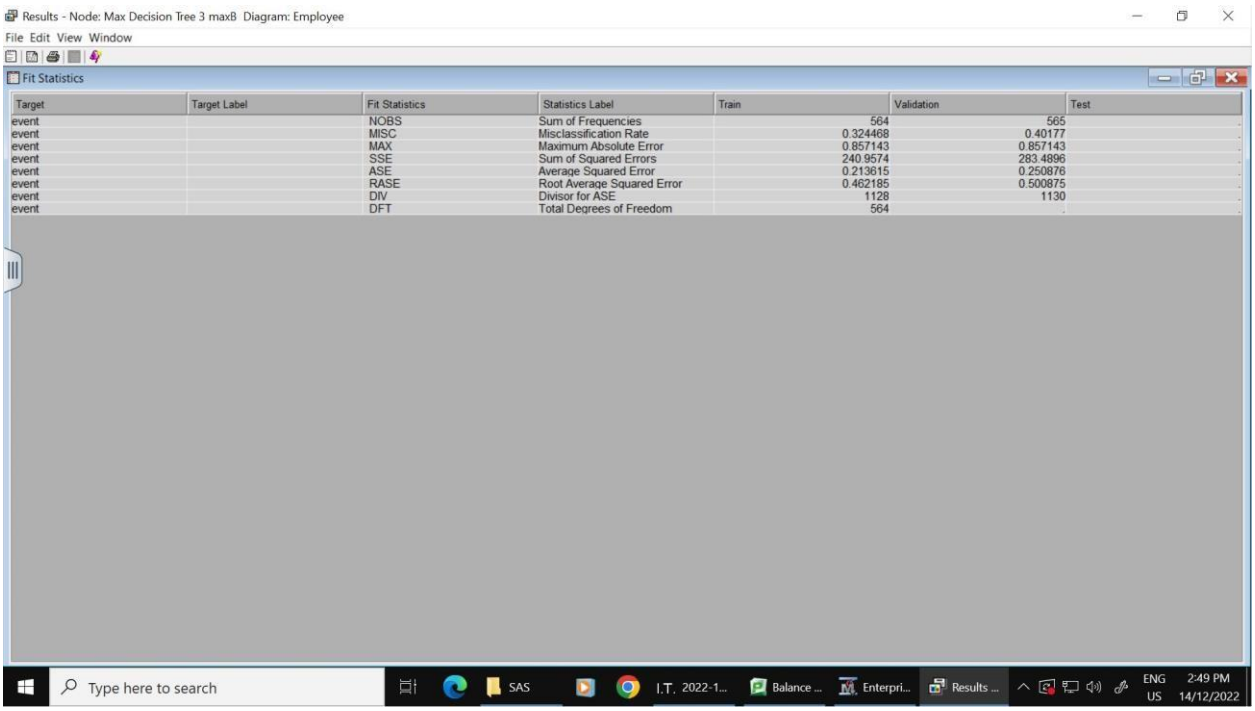
The Validation Average Square Error for the two-branch Maximal Tree is 0.24507.

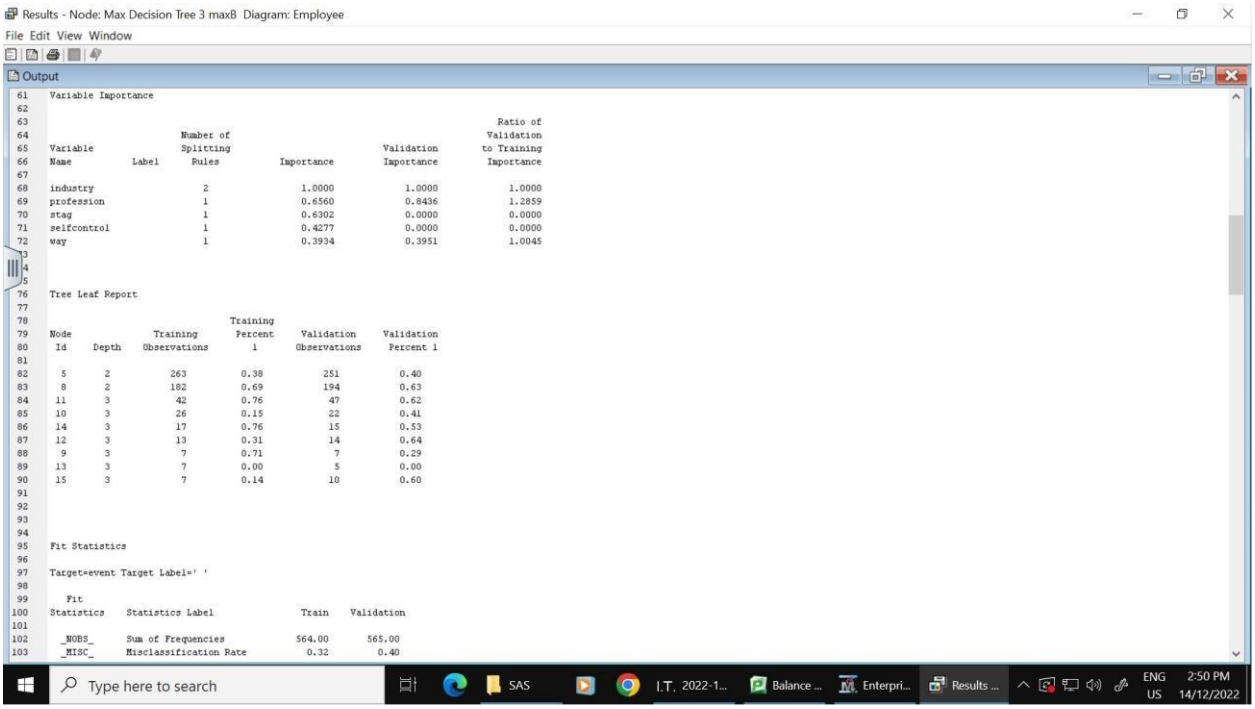
THREE-BRANCH MAXIMAL TREE

The decision tree node was attached to the data partition node with a maximum of three branches indicated, ‘largest’ used as the method and ‘decision’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Results - Node: Max Decision Tree 3 maxB Diagram: Employee
File Edit View Window
Leaf Statistics
Training Percent 1
Validation Percent 1
Tree
Score Rankings Overlay: event
Cumulative Lift
TRAIN
VALIDATE
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event NOBS Sum of Fr... 564 565
event MISC Misclassifi... 0.324468 0.40177
event MAX Maximum ... 0.857143 0.857143
Treemap
Output
User: 301259629
Date: December 14, 2022
Time: 11:52:31
Property
Value
Maximum Branch 3
Maximum Depth 6
Minimum Categorical Size 5
Node
Leaf Size 5
Number of Rules 5
Number of Surrogate Rules 0
Split Size
Split Search
Use Decisions No
Use Priors No
Exhaustive 5000
Node Sample 20000
Subtree
Method Largest
Number of Leaves 1
Assessment Measure Decision
General
General Properties
Diagram Log
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-25
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
2:49 PM 14/12/2022

Results - Node: Max Decision Tree 3 maxB Diagram: Employee
File Edit View Window
Tree
industry
POWERGENERATION, RETAIL...
BANKS, CONSULT, STATE, E...
profession
way
IT
HR, ETC, BUSINESSDEVELO...
COMMERCIAL, SALES, FINAN...
FOOT
BUS, CAR Or Missing
selfcontrol
industry
stag
>= 3.7 Or Missing
RETAIL, MANUFACTURE
Missing Values Only
< 4.6817
[4.6817, 50.7598) Or Missing
>= 50.7598
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
2:49 PM 14/12/2022



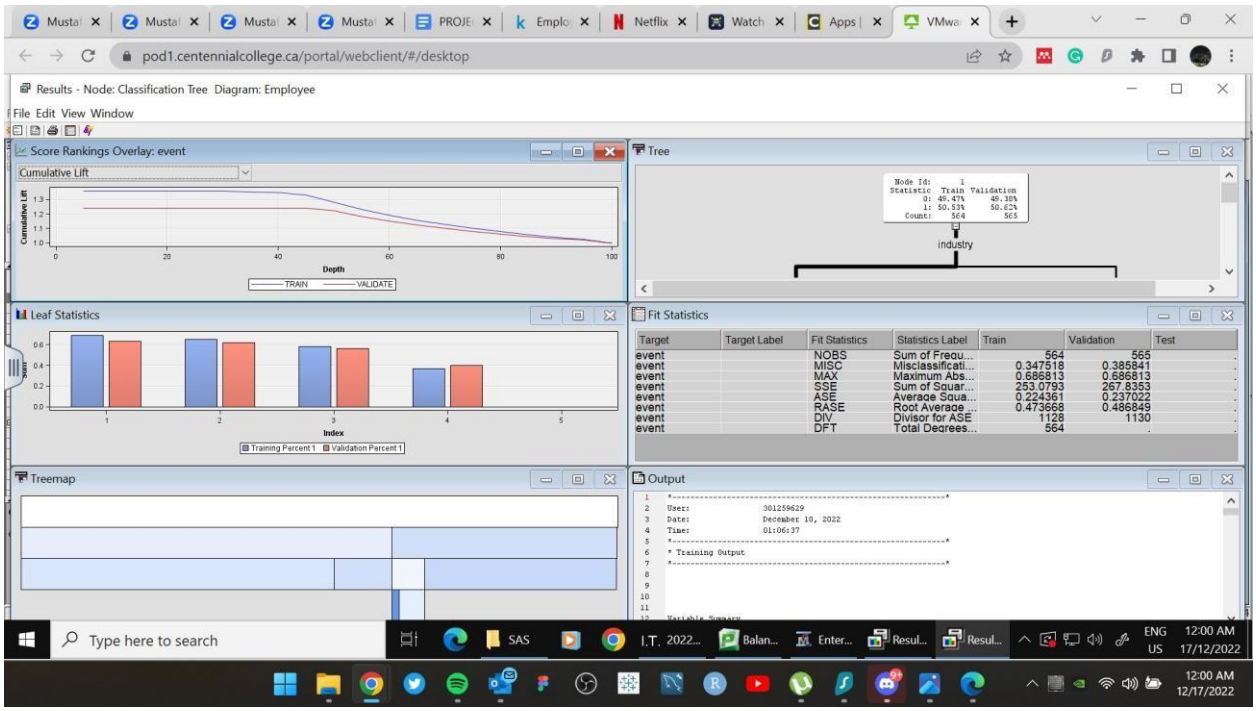


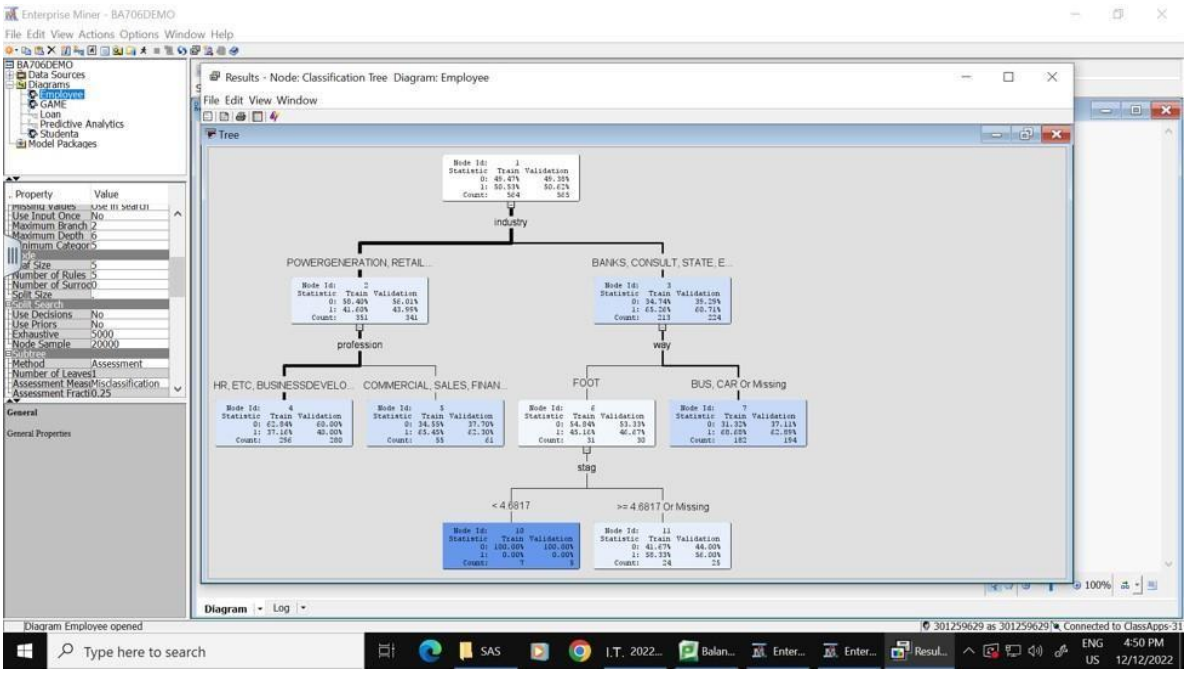
The tree had nine leaves with five variable splits. The first split occurs at the Industry variable with the highest logworth when compared to the other variables selected in the model. The tree shows that 62.89% of employees in Banks, Consult and State who go to work in vehicles are likely to quit their jobs. 60% of employees who have worked greater than 51 months in the Bank, Consult, and State industries and walk to the office are likely to quit. 62.3% of Commercial, Sales, and Finance professionals in the power generation industry are likely to quit.

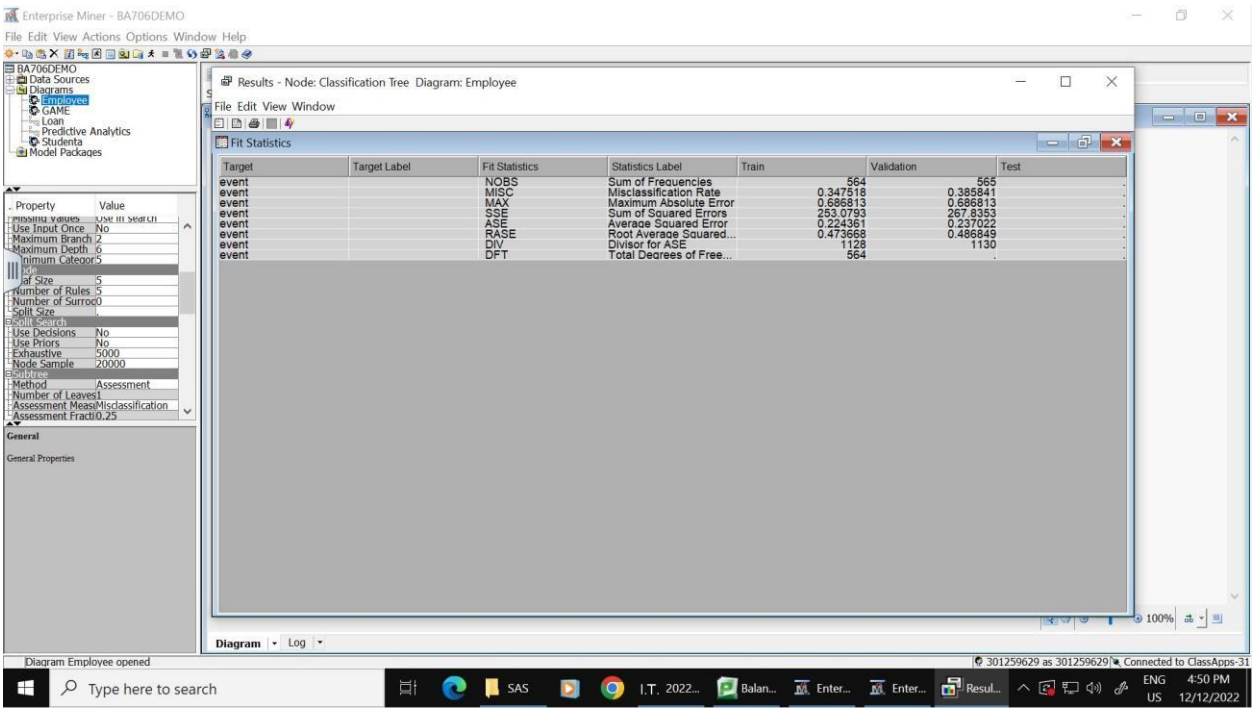
The Validation Average Square Error for the three-branch Maximal Tree is 0.250876. We observed that the Two Branch Maximal Tree is a better model than the Three Branch Maximal tree, as this has a higher Validation Average Square Error.

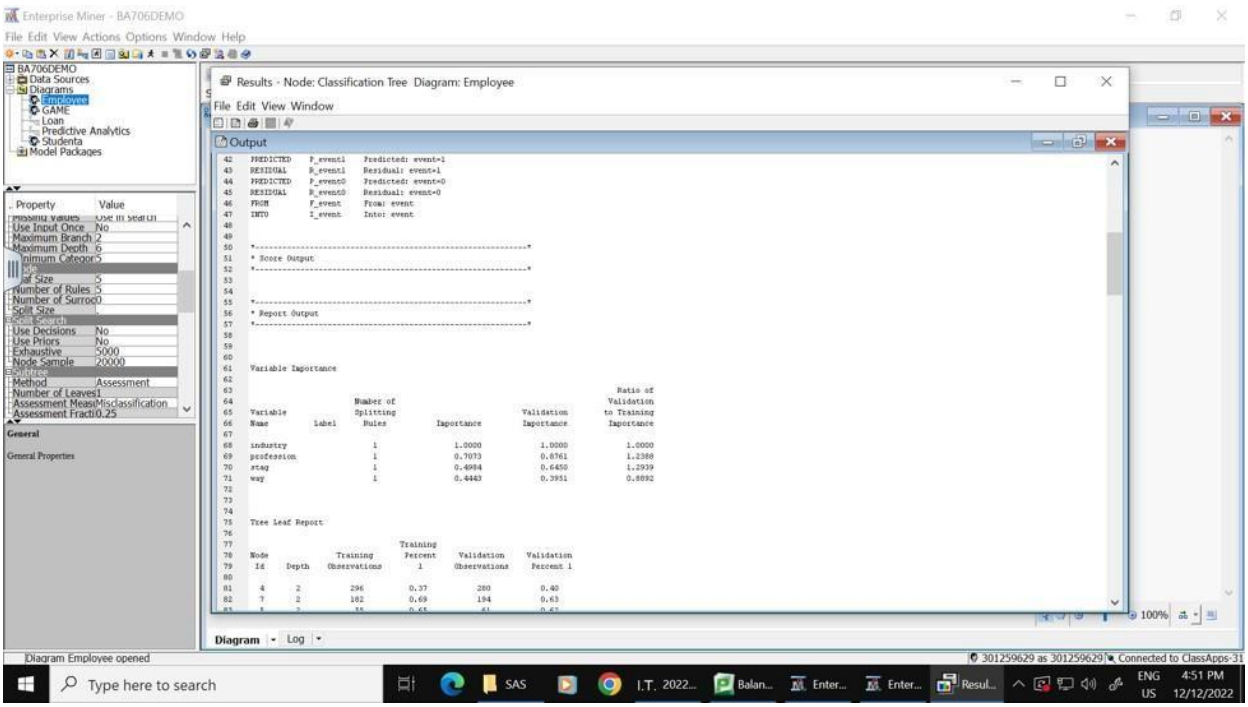
TWO-BRANCH CLASSIFICATION TREE

The decision tree node was attached to the data partition node with a maximum of two branches indicated, ‘assessment’ was used for the method and ‘misclassification’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.




Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Classification Tree Diagram: Employee
File Edit View Window
Tree
industry
POWERGENERATION, RETAIL...
BANKS, CONSULT, STATE, E...
profession
way
HR, ETC, BUSINESSDEVELO...
COMMERCIAL, SALES, FINAN...
FOOT
BUS, CAR Or Missing
stag
< 4.6817
>= 4.6817 Or Missing
Diagram
Log
Diagram Employee opened
Type here to search


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
Results - Node: Classification Tree Diagram: Employee
File Edit View Window
Fit Statistics
Target | Target Label | Fit Statistics | Statistics Label | Train | Validation | Test
event | | NOBS | Sum of Frequencies | 564 | 565 |
event | | MISC | Misclassification Rate | 0.347518 | 0.385841 |
event | | MAX | Maximum Absolute Error | 0.686813 | 0.686813 |
event | | SSE | Sum of Squared Errors | 253.0793 | 267.8353 |
event | | ASE | Average Squared Error | 0.224361 | 0.237022 |
event | | RASE | Root Average Squared... | 0.473668 | 0.486849 |
event | | DIV | Divisor for ASE | 1128 | 1130 |
event | | DFT | Total Degrees of Free... | 564 |
Diagram
Log
Diagram Employee opened
Type here to search

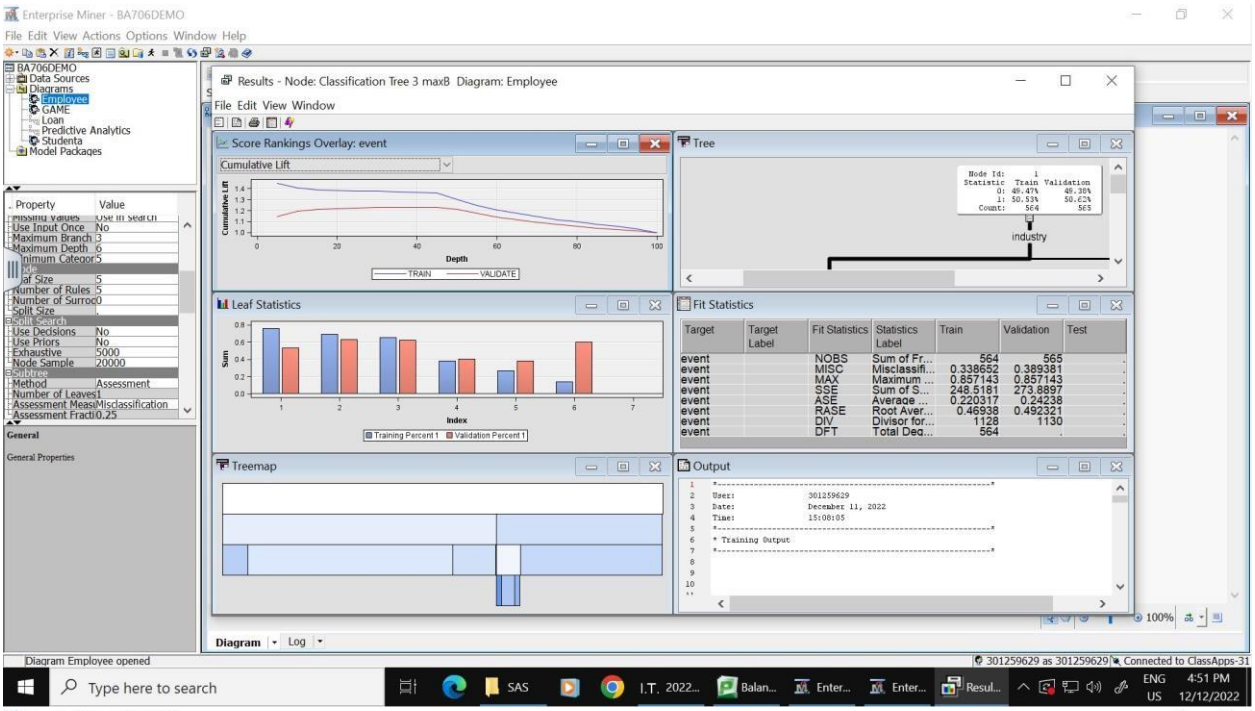


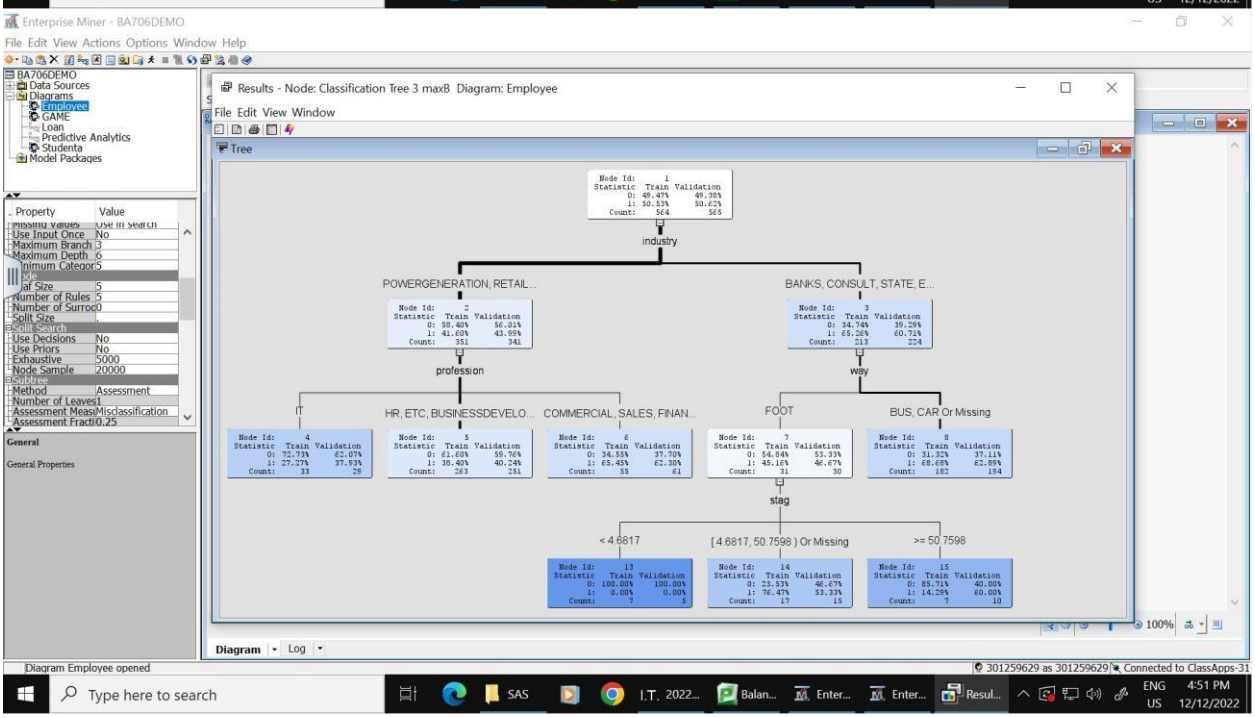
The tree has five leaves with four variable splits. This reduction is a result of pruning using the misclassification measure. The first split occurs at the Industry variable with the highest logworth when compared to the other variables selected in the model. The tree shows that 62.89% of employees in Banks, Consult and State industries who go to work in vehicles are likely to quit their jobs. 56% of employees who have worked greater than 4.7 months in the Bank, Consult, and State industries and walk to the office are likely to quit. 62.3% of Commercial, Sales, and Finance professionals in the power generation industry are also likely to quit.

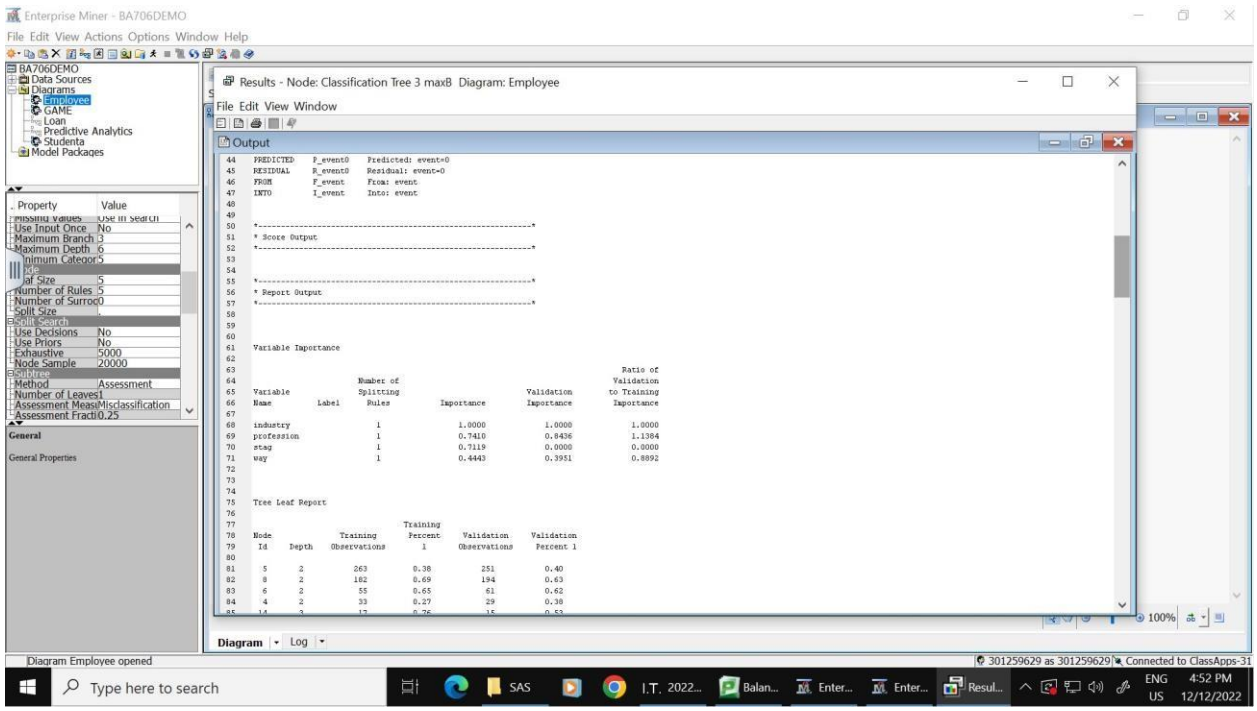
The Validation Average Square Error for the two-branch classification Tree is 0.237022.

THREE-BRANCH CLASSIFICATION TREE

The decision tree node was attached to the data partition node with a maximum of three branches indicated, ‘assessment’ used as the method and ‘misclassification’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Classification Tree 3 maxB Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Depth
TRAIN
VALIDATE
Tree
industry
Leaf Statistics
Index
Training Percent 1
Validation Percent 1
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event NOBS Sum of Fr... 564 565
event MISC Misclassifi... 0.338652 0.389381
event MAX Maximum ... 0.857143 0.857143
event SSE Sum of S... 248.5181 273.8897
event ASE Average ... 0.220317 0.24238
event RASE Root Aver... 0.46938 0.492321
event DIV Divisor for... 1128 1130
event DFT Total Deg... 564
Treemap
Output
Training Output
Diagram
Log
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-31
Type here to search
ENG US
4:51 PM
12/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Classification Tree 3 maxB Diagram: Employee
File Edit View Window
Tree
industry
POWERGENERATION, RETAIL...
BANKS, CONSULT, STATE, E...
profession
way
IT
HR, ETC, BUSINESSDEVELO...
COMMERCIAL, SALES, FINAN...
FOOT
BUS, CAR Or Missing
stag
< 4.6817
[4.6817, 50.7598) Or Missing
>= 50.7598
Diagram
Log
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-31
Type here to search
ENG US
4:51 PM
12/12/2022



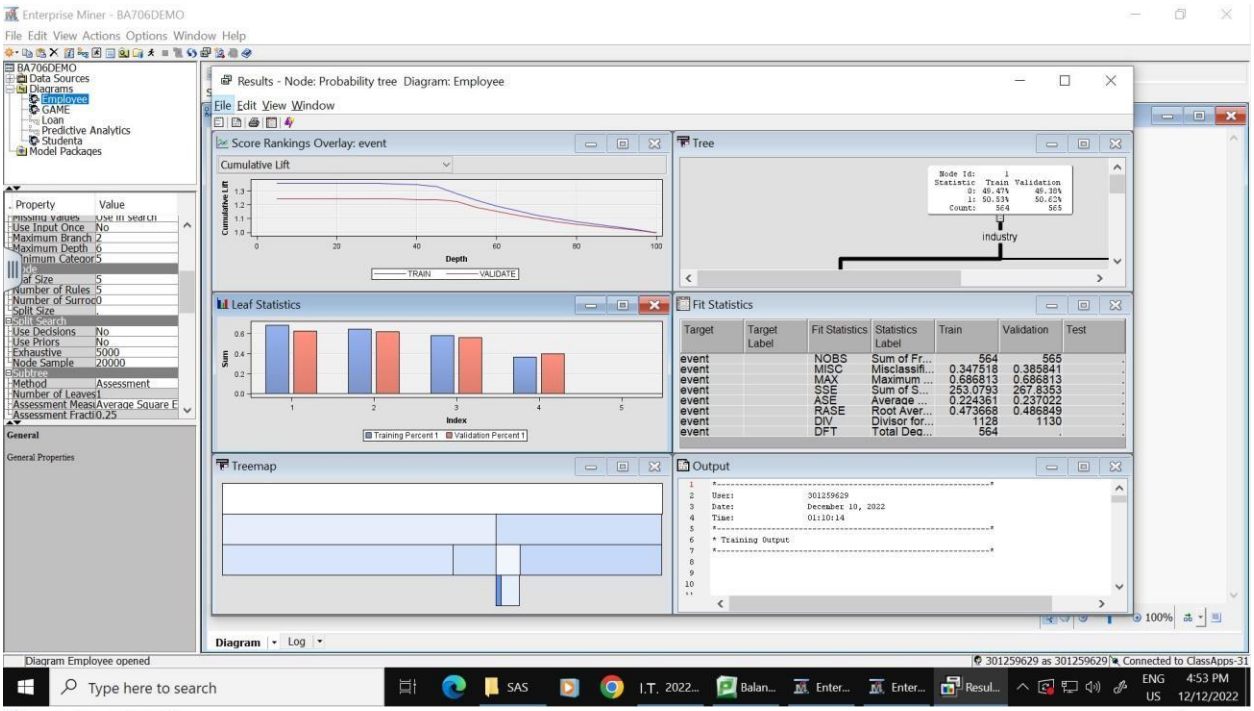
The tree has seven leaves with four variable splits. The increased number of branches also increased the number of leaves when compared to the two branch model. The tree shows that 62.89% of employees in Banks, Consult and State who go to work in vehicles are likely to quit their jobs. 60% of employees who have worked greater than 51 months in the Bank, Consult, and State industries and walk to the office are likely to quit. 62.3% of Commercial, Sales, and Finance professionals in the power generation industry are likely to quit.

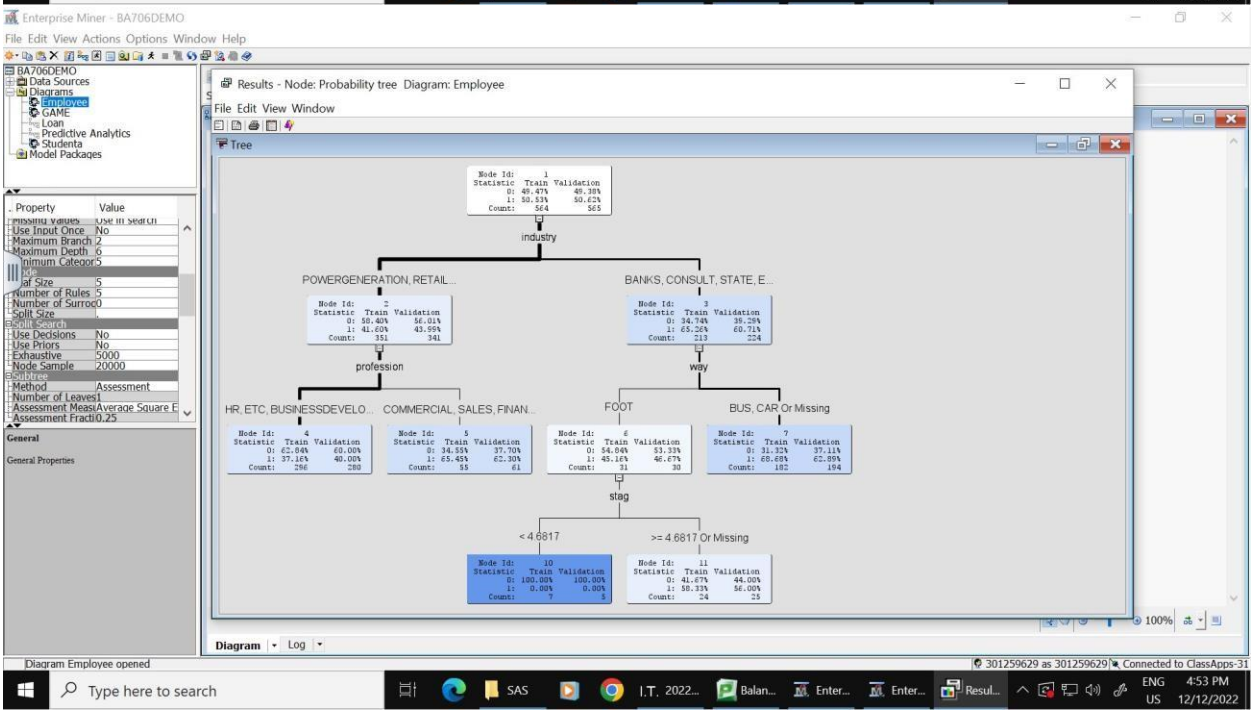
The Validation Average Square Error for the three-branch classification Tree is 0.24238. The Two Branch Classification Tree is a better model than the Three Branch Classification tree, as it has a lower Validation Average Square Error.

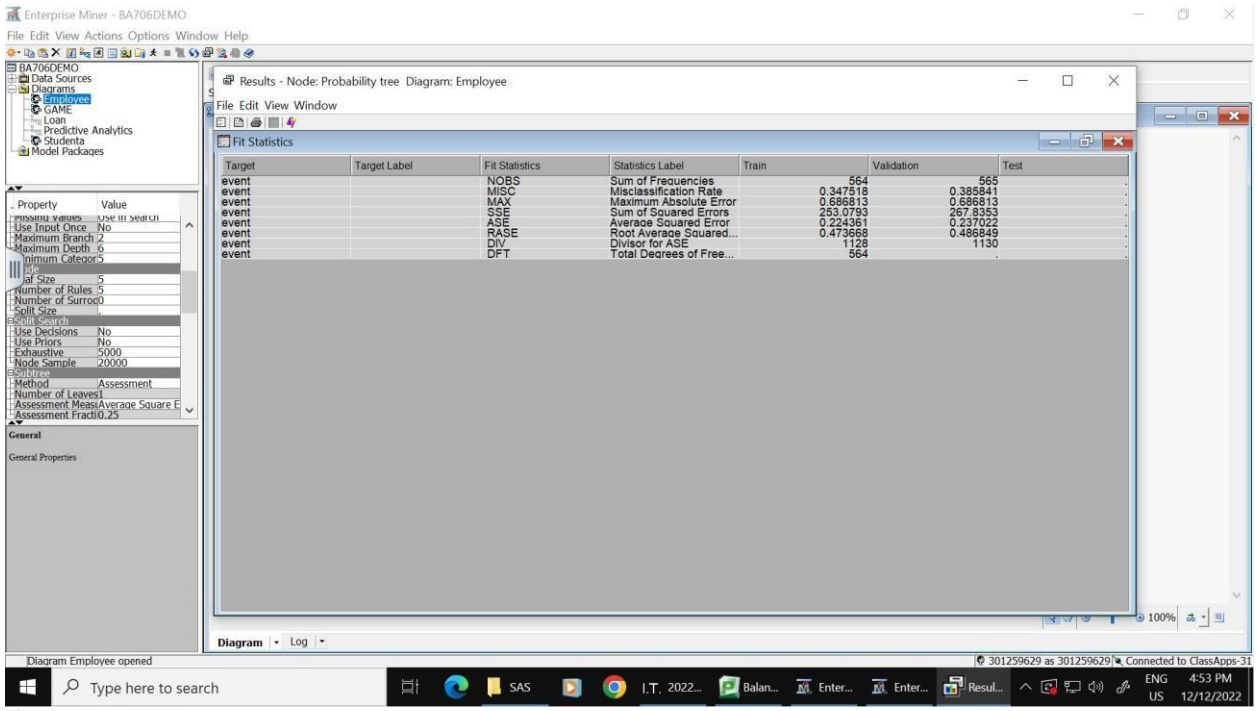
.

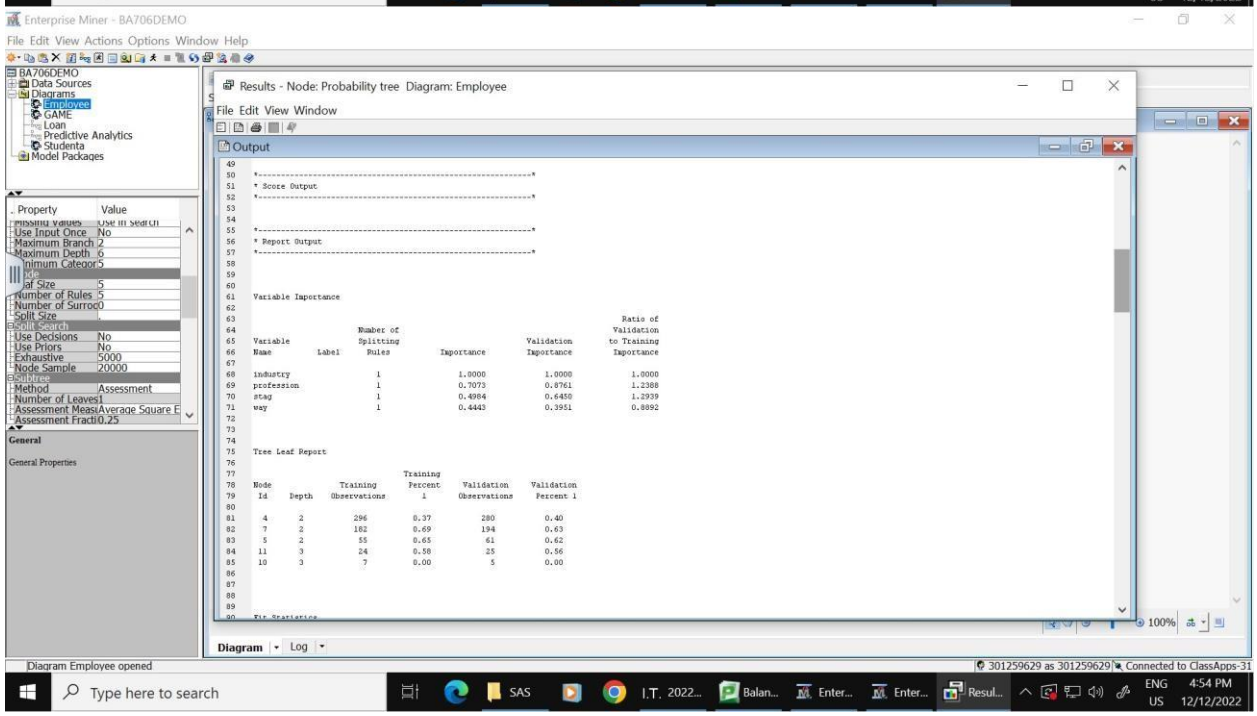
TWO BRANCH PROBABILITY TREE

The decision tree node was attached to the data partition node with a maximum branch of two, ‘assessment’ used as the method and ‘average squared error’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Probability tree Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Depth
TRAIN
VALIDATE
Tree
industry
Leaf Statistics
Training Percent 1
Validation Percent 1
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event
NOBS
Sum of Fr...
564
565
event
MISC
Misclassifi...
0.347518
0.385841
event
MAX
Maximum ...
0.686813
0.686813
event
SSE
Sum of S...
253.0793
267.8353
event
ASE
Average ...
0.224361
0.237022
event
RASE
Root Aver...
0.473668
0.486849
event
DIV
Divisor for...
1128
1130
event
DFT
Total Deg...
564
Treemap
Output
Diagram
Log
Diagram Employee opened
Connected to ClassApps-31
Type here to search
ENG
US
4:53 PM
12/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Probability tree Diagram: Employee
File Edit View Window
Tree
industry
POWERGENERATION, RETAIL...
BANKS, CONSULT, STATE, E...
profession
way
HR, ETC, BUSINESSDEVELO...
COMMERCIAL, SALES, FINAN...
FOOT
BUS, CAR Or Missing
stag
< 4.6817
>= 4.6817 Or Missing
Diagram
Log
Diagram Employee opened
Connected to ClassApps-31
Type here to search
ENG
US
4:53 PM
12/12/2022



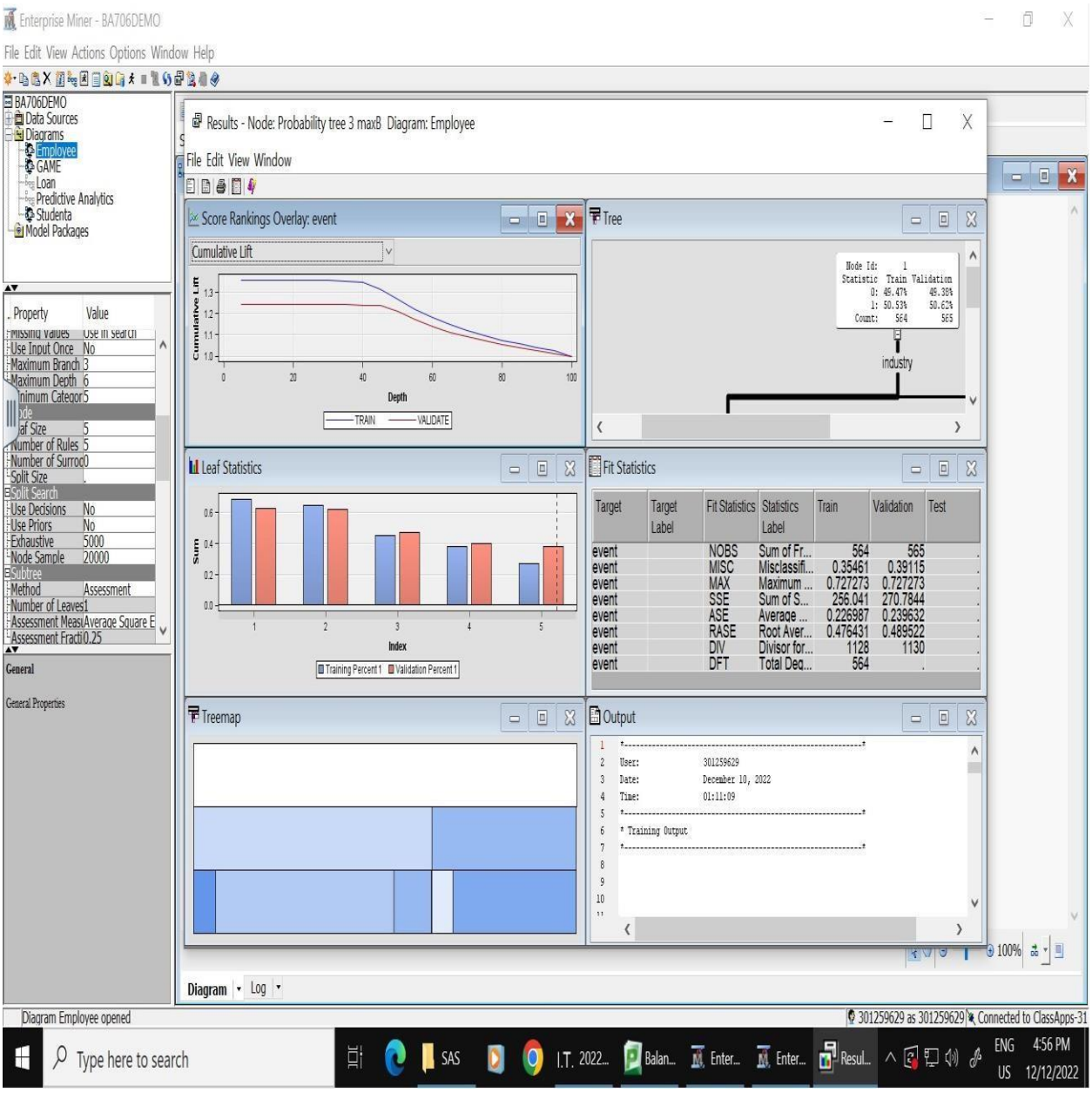


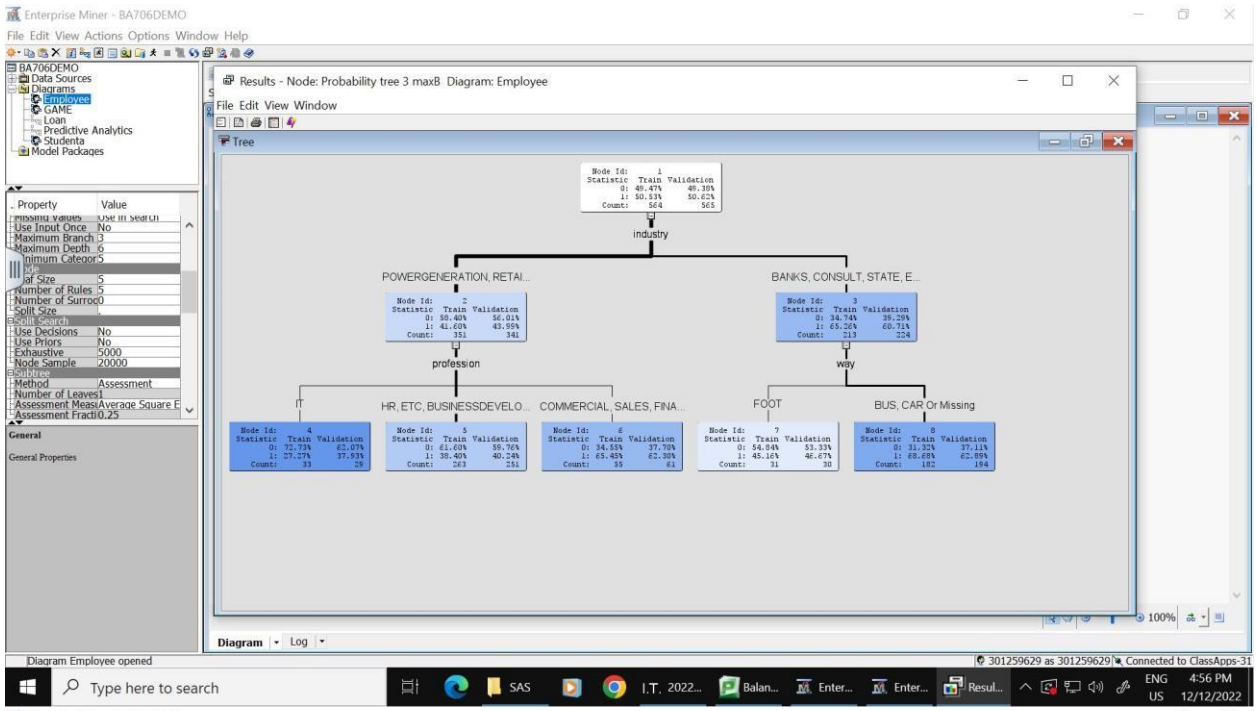
The tree has five leaves with four variable splits. this reduction is a result of pruning using the average squared error measure. The tree shows that 62.89% of employees in Banks, Consult and State industries who go to work in vehicles are likely to quit their jobs. 56% of employees who have worked greater than 4.7 months in the Bank, Consult, and State industries and walk to the office are likely to quit. 62.3% of Commercial, Sales, and Finance professionals in the power generation, and retail industry are also likely to quit.

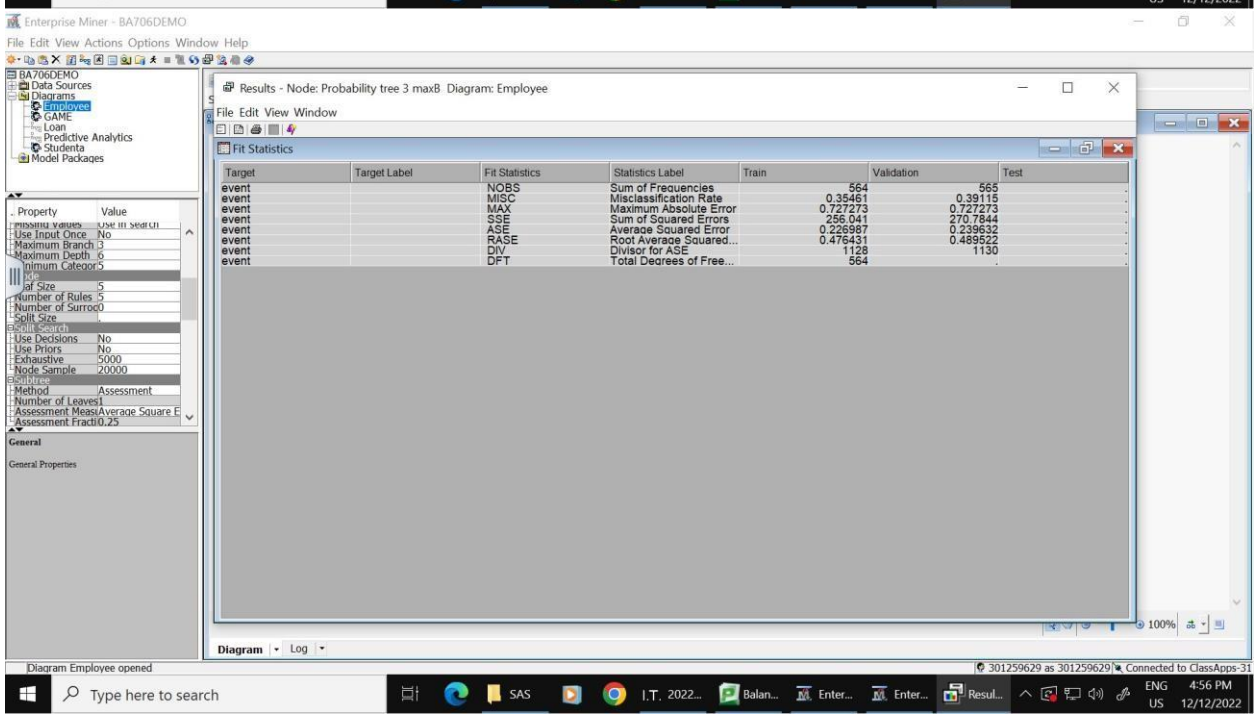
The Validation Average Square Error for the two-branch classification Tree is 0.237022. This has a similar validation ASE as the two-branch classification tree model.

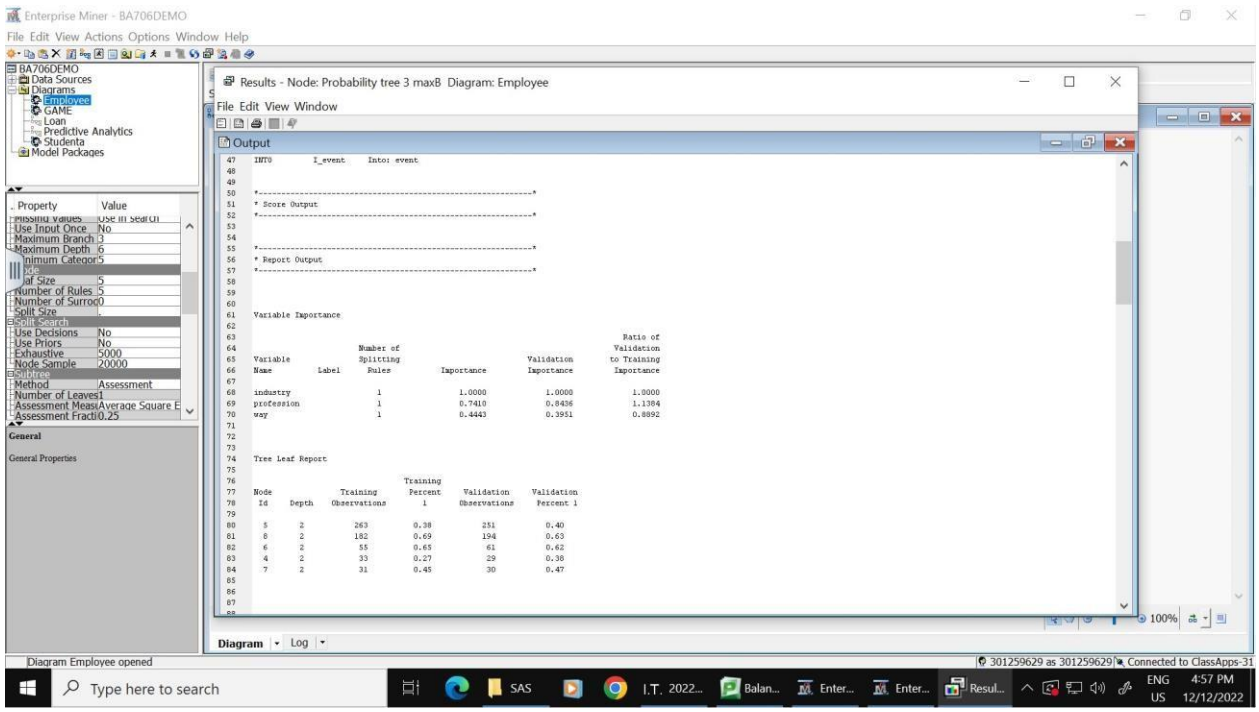
THREE BRANCH PROBABILITY TREE

The decision tree node was attached to the data partition node with a maximum branch of three, ‘assessment’ used as the method and ‘average squared error’ as the assessment measure. Below shows the outcome after this node was run with the specifications noted.


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Probability tree 3 maxB Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Cumulative Lift
Depth
TRAIN
VALIDATE
Tree
Node Id: 1
Statistic Train Validation
0: 49.47% 49.38%
1: 50.53% 50.62%
Count: 564 565
industry
Leaf Statistics
Sum
Index
Training Percent 1
Validation Percent 1
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event NOBS Sum of Fr... 564 565
event MISC Misclassifi... 0.35461 0.39115
event MAX Maximum ... 0.727273 0.727273
event SSE Sum of S... 256.041 270.7844
event ASE Average ... 0.226987 0.239632
event RASE Root Aver... 0.476431 0.489522
event DIV Divisor for... 1128 1130
event DFT Total Deg... 564
Treemap
Output
User: 301259629
Date: December 10, 2022
Time: 01:11:09
* Training Output
Property
Value
Use Input Once No
Maximum Branch 3
Maximum Depth 6
Leaf Size 5
Number of Rules 5
Number of Surrog 0
Split Size
Split Search
Use Decisions No
Use Priors No
Exhaustive 5000
Node Sample 20000
Subtree
Method Assessment
Number of Leaves 1
Assessment Fracti 0.25
General
General Properties
Diagram
Log
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-31
Type here to search
SAS
I.T. 2022...
Balan...
Enter...
Enter...
Resul...
ENG US
4:56 PM
12/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Probability tree 3 maxB Diagram: Employee
File Edit View Window
Tree
Node Id: 1
Statistic Train Validation
0: 49.47% 49.38%
1: 50.53% 50.62%
Count: 564 565
industry
POWERGENERATION, RETAI...
BANKS, CONSULT, STATE, E...
Node Id: 2
Statistic Train Validation
0: 58.40% 56.01%
1: 41.60% 43.99%
Count: 351 341
Node Id: 3
Statistic Train Validation
0: 34.74% 35.29%
1: 65.26% 64.71%
Count: 213 224
profession
way
IT
HR, ETC, BUSINESSDEVELO...
COMMERCIAL, SALES, FINA...
FOOT
BUS, CAR Or Missing
Node Id: 4
Statistic Train Validation
0: 72.73% 62.07%
1: 27.27% 37.93%
Count: 33 29
Node Id: 5
Statistic Train Validation
0: 61.60% 59.76%
1: 38.40% 40.24%
Count: 243 251
Node Id: 6
Statistic Train Validation
0: 34.55% 37.70%
1: 65.45% 62.30%
Count: 55 61
Node Id: 7
Statistic Train Validation
0: 54.84% 53.33%
1: 45.16% 46.67%
Count: 31 30
Node Id: 8
Statistic Train Validation
0: 31.32% 37.11%
1: 68.68% 62.89%
Count: 182 194
Property Value
Use Input Once No
Maximum Branch 3
Maximum Depth 6
Leaf Size 5
Number of Rules 5
Number of Surroc 0
Split Size
Use Decisions No
Use Priors No
Exhaustive 5000
Node Sample 20000
Method Assessment
Number of Leaves 1
Assessment Fracti 0.25
General
General Properties
Diagram
Log
100%
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-31
Type here to search
SAS
I.T. 2022...
Balan...
Enter...
Enter...
Resul...
ENG US
4:56 PM
12/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Results - Node: Probability tree 3 maxB Diagram: Employee
File Edit View Window
Fit Statistics
Target Target Label Fit Statistics Statistics Label Train Validation Test
event NOBS Sum of Frequencies 564 565
event MISC Misclassification Rate 0.35461 0.39115
event MAX Maximum Absolute Error 0.727273 0.727273
event SSE Sum of Squared Errors 256.041 270.7844
event ASE Average Squared Error 0.226987 0.239632
event RASE Root Average Squared... 0.476431 0.489522
event DIV Divisor for ASE 1128 1130
event DFT Total Degrees of Free... 564
Property Value
Use Input Once No
Maximum Branch 3
Maximum Depth 6
Leaf Size 5
Number of Rules 5
Number of Surroc 0
Split Size
Use Decisions No
Use Priors No
Exhaustive 5000
Node Sample 20000
Method Assessment
Number of Leaves 1
Assessment Fracti 0.25
General
General Properties
Diagram
Log
100%
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-31
Type here to search
SAS
I.T. 2022...
Balan...
Enter...
Enter...
Resul...
ENG US
4:56 PM
12/12/2022

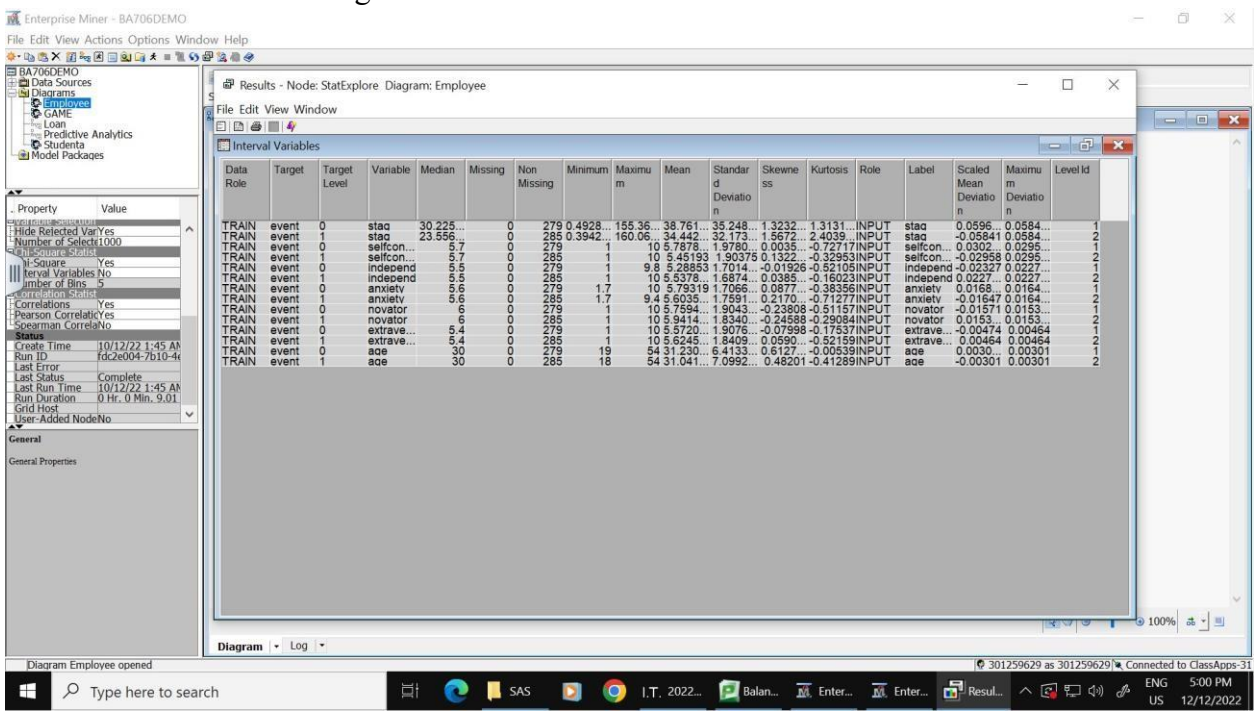


The tree has five leaves with three variable splits. This model has the least amount of significant variables when compared to all the other tree models. The stag variable which shows the amount of time an employee has worked was not considered significant enough to be included. The tree shows that 62.89% of employees in Banks, Consult and State who go to work in vehicles are likely to quit their jobs. 62.3% of Commercial, Sales, and Finance professionals in the power generation industry are likely to quit.

The Validation Average Square Error for the three-branch classification Tree is 0.239632. The Two Branch Probability Tree gives a higher validation assessment than this tree.

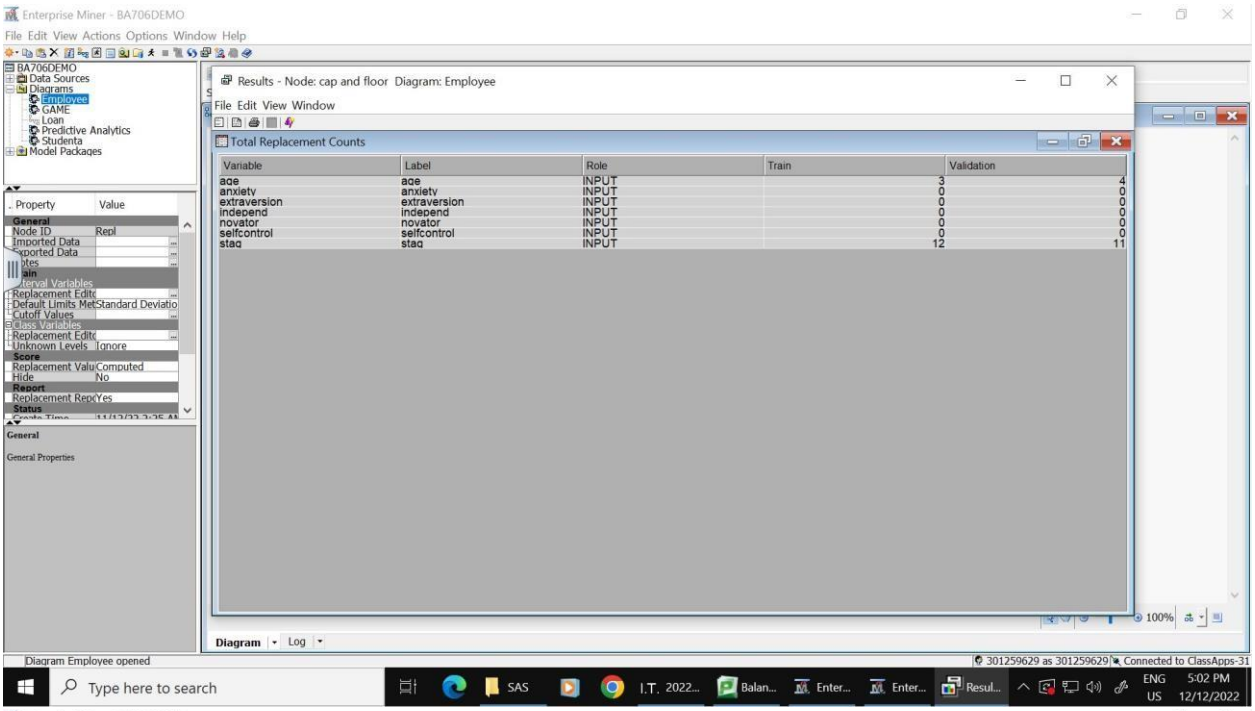
EXPLORING OUR DATA

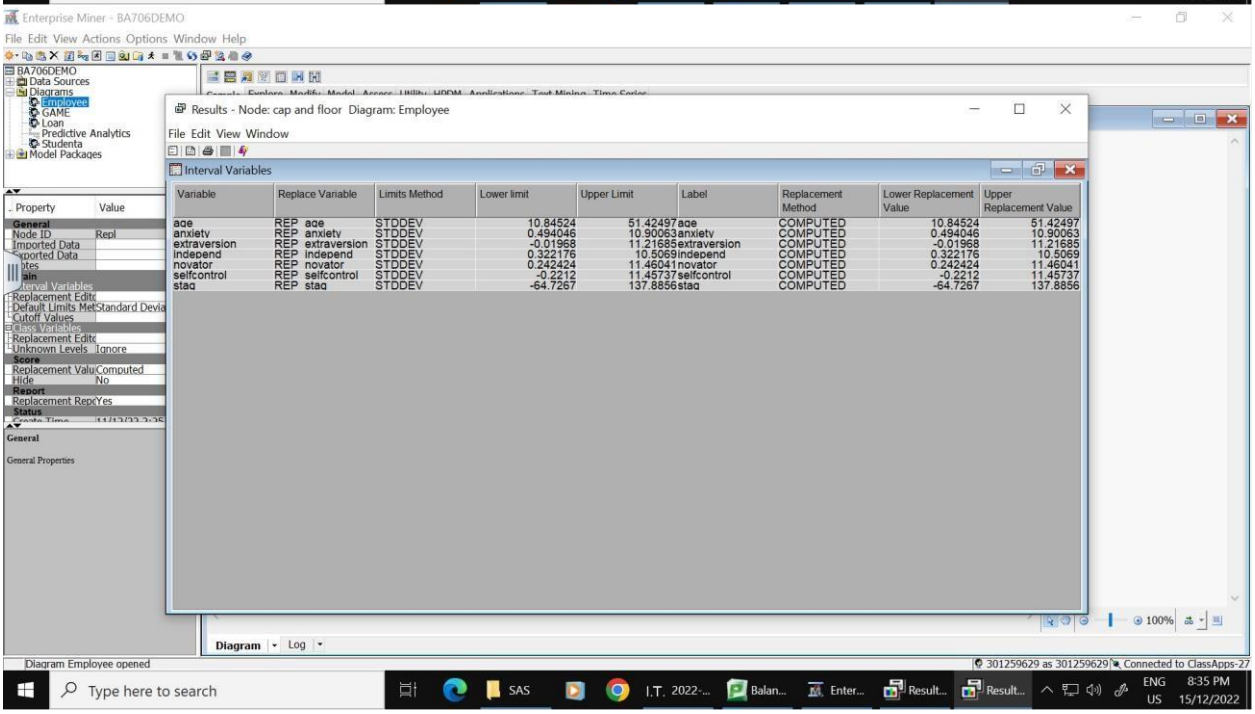
After we were done with analyzing our decision trees we decided to do a state explore to see if we have any missing values in the dataset. As decision trees are forgiving with respect to data, they are not affected by missing values, this step was not necessary before the tree models. However, for the next set of models, regressions and neural networks, the models are unable to run if there are values missing.



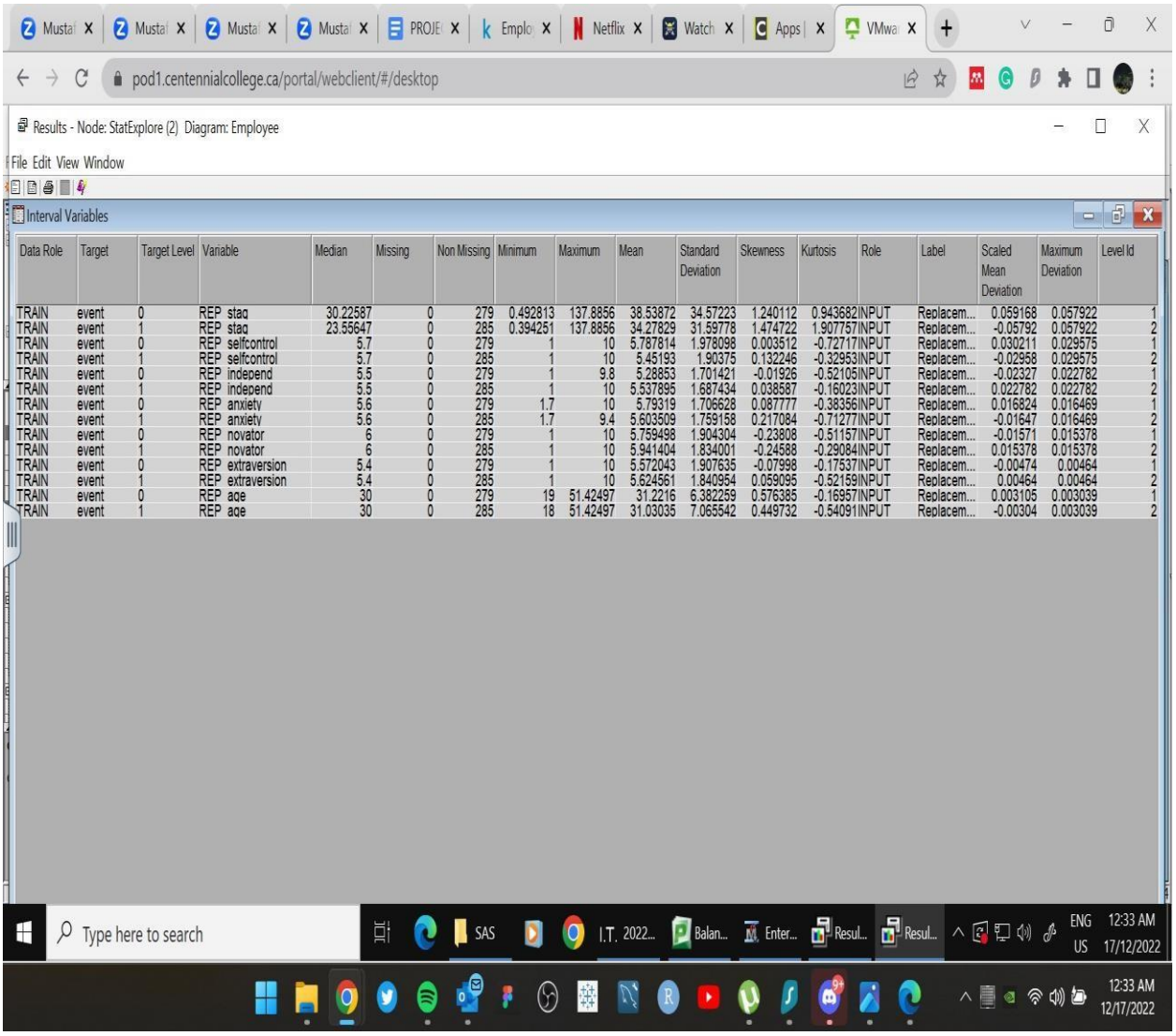
CAP AND FLOOR

We noticed there were no missing values, hence no impute node required in the diagram. However, there was a skewness in the dataset so we resolved it with a cap and floor by connecting a replacement node. The result shows that the variables ‘age’ and ‘stag’ were affected after running the cap and floor. Age was capped at 51.42497 and floored at 10.84524 while stag was capped and floored at 137.8856 and 64.7267 respectively.



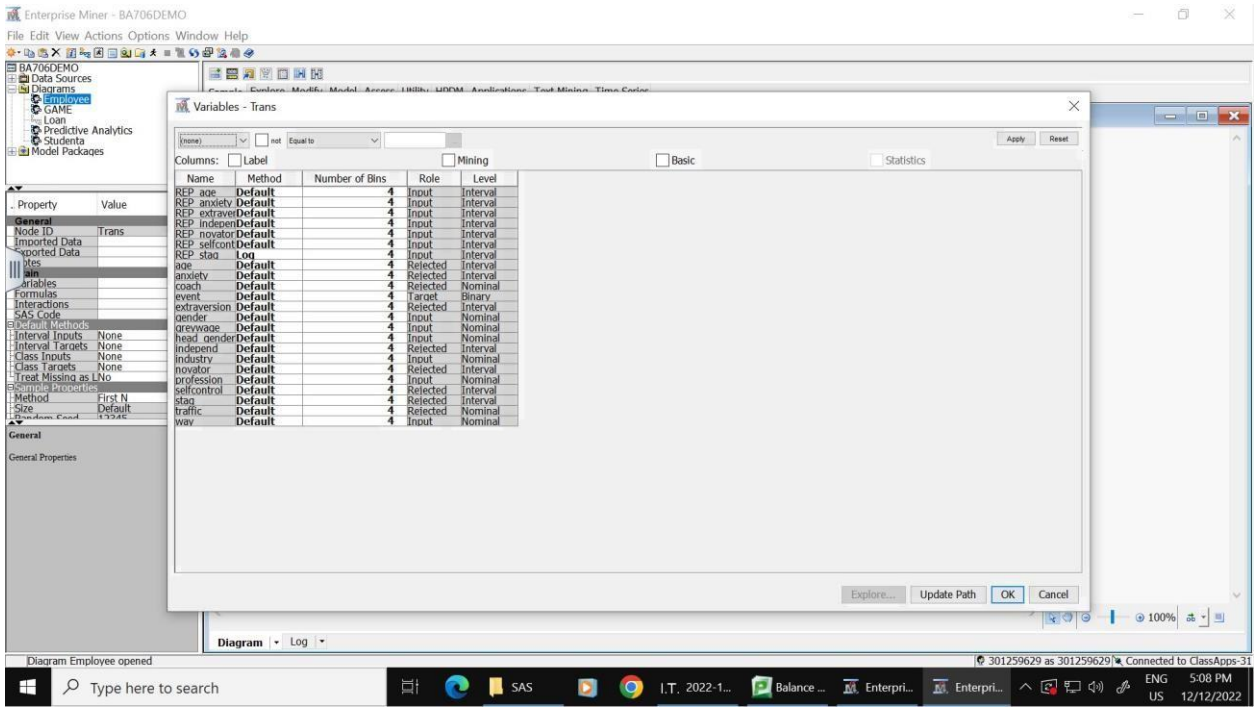


A stat explore node was connected to the replacement node to see the effect of the cap and floor on the skewed values.

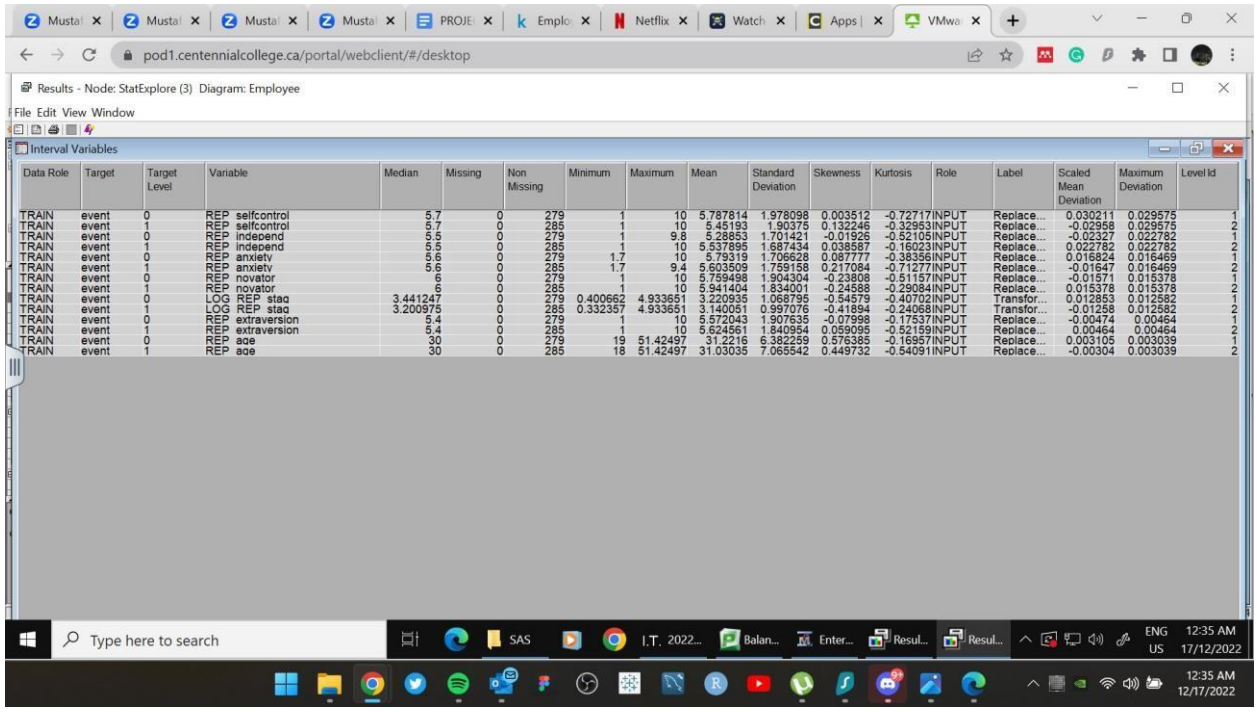


Data Role	Target	Target Level	Variable	Median	Missing	Non Missing	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis	Role	Label	Scaled Mean Deviation	Maximum Deviation	Level Id
TRAIN	event	0	REP staq	30.22587	0	279	0.492813	137.8856	38.53872	34.57223	1.240112	0.943682	INPUT	Replacem...	0.059168	0.057922	1
TRAIN	event	1	REP staq	23.55647	0	285	0.394251	137.8856	34.27829	31.59778	1.474722	1.907757	INPUT	Replacem...	-0.05792	0.057922	2
TRAIN	event	0	REP selfcontrol	5.7	0	279	1	10	5.787814	1.978098	0.003512	-0.72717	INPUT	Replacem...	0.030211	0.029575	1
TRAIN	event	1	REP selfcontrol	5.7	0	285	1	10	5.45193	1.90375	0.132246	-0.32953	INPUT	Replacem...	-0.02958	0.029575	2
TRAIN	event	0	REP independ	5.5	0	279	1	9.8	5.28853	1.701421	-0.01926	-0.52105	INPUT	Replacem...	-0.02327	0.022782	1
TRAIN	event	1	REP independ	5.5	0	285	1	10	5.537895	1.687434	0.038587	-0.16023	INPUT	Replacem...	0.022782	0.022782	2
TRAIN	event	0	REP anxiety	5.6	0	279	1.7	10	5.79319	1.706628	0.087777	-0.38356	INPUT	Replacem...	0.016824	0.016469	1
TRAIN	event	1	REP anxiety	5.6	0	285	1.7	9.4	5.603509	1.759158	0.217084	-0.71277	INPUT	Replacem...	-0.01647	0.016469	2
TRAIN	event	0	REP novator	6	0	279	1	10	5.759498	1.904304	-0.23808	-0.51157	INPUT	Replacem...	-0.01571	0.015378	1
TRAIN	event	1	REP novator	6	0	285	1	10	5.941404	1.834001	-0.24588	-0.29084	INPUT	Replacem...	0.015378	0.015378	2
TRAIN	event	0	REP extraversion	5.4	0	279	1	10	5.572043	1.907635	-0.07998	-0.17537	INPUT	Replacem...	-0.00474	0.00464	1
TRAIN	event	1	REP extraversion	5.4	0	285	1	10	5.624561	1.840954	0.059095	-0.52159	INPUT	Replacem...	0.00464	0.00464	2
TRAIN	event	0	REP age	30	0	279	19	51.42497	31.2216	6.382259	0.576385	-0.16957	INPUT	Replacem...	0.003105	0.003039	1
TRAIN	event	1	REP age	30	0	285	18	51.42497	31.03035	7.065542	0.449732	-0.54091	INPUT	Replacem...	-0.00304	0.003039	2

After exploring cap and floor, we realized that the data was still skewed on the Rep stag(which was imputed by the cap and floor to fix the initial skewness of the data). So we used a log transform to try and fix the skewness.



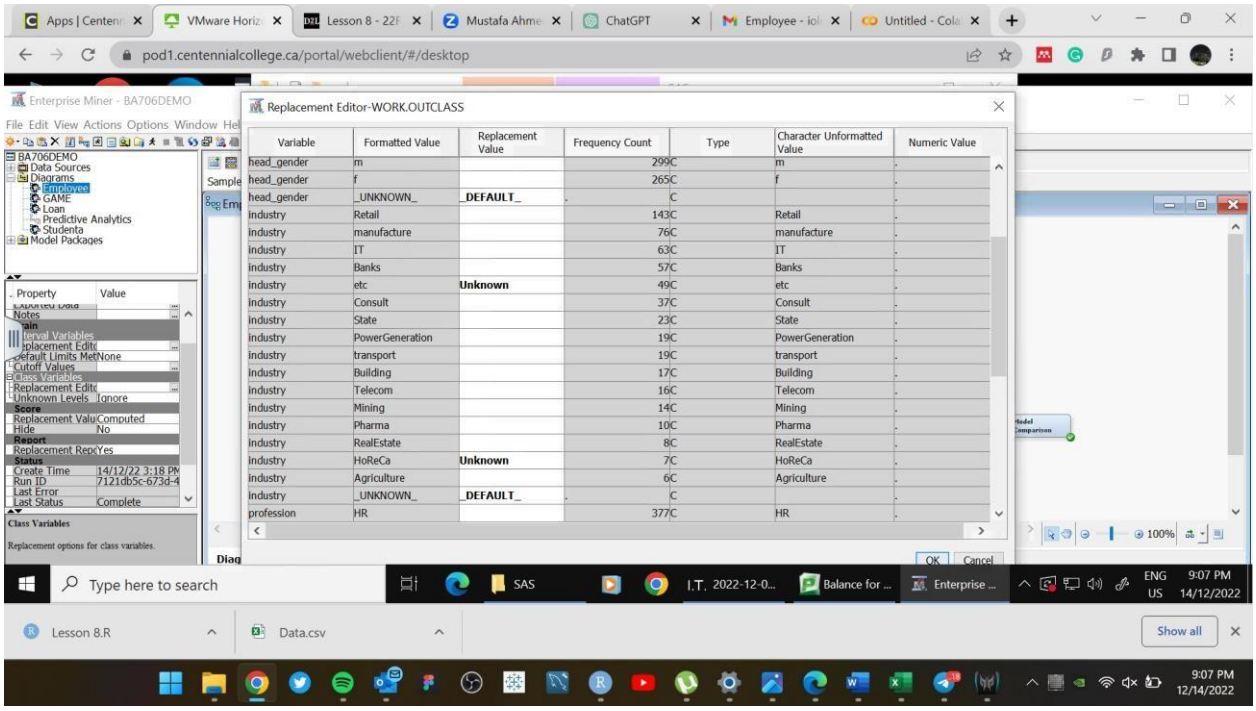
Next was to stat explore the data and we noticed the skewness was sorted as shown below:



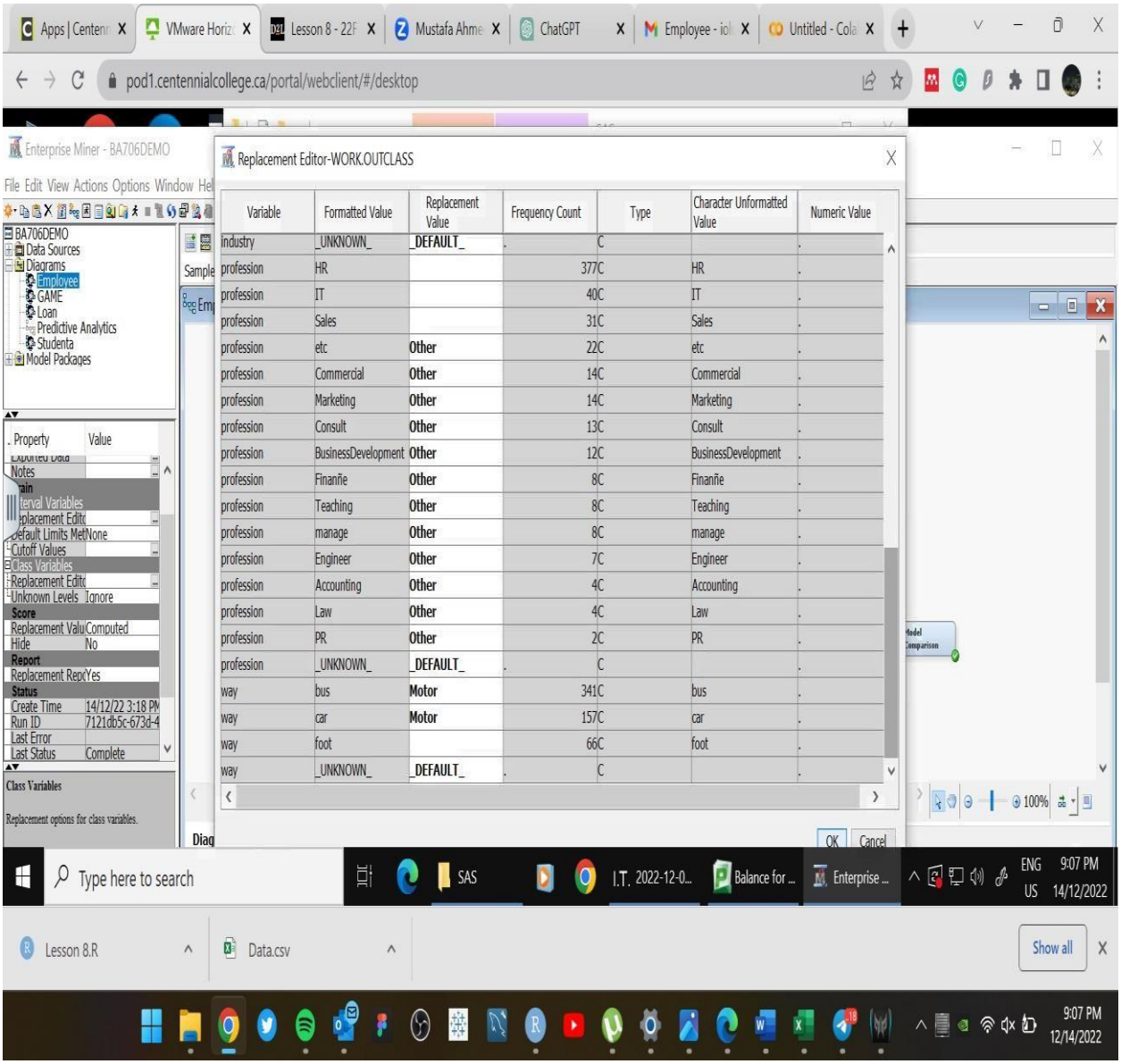
REPLACEMENT

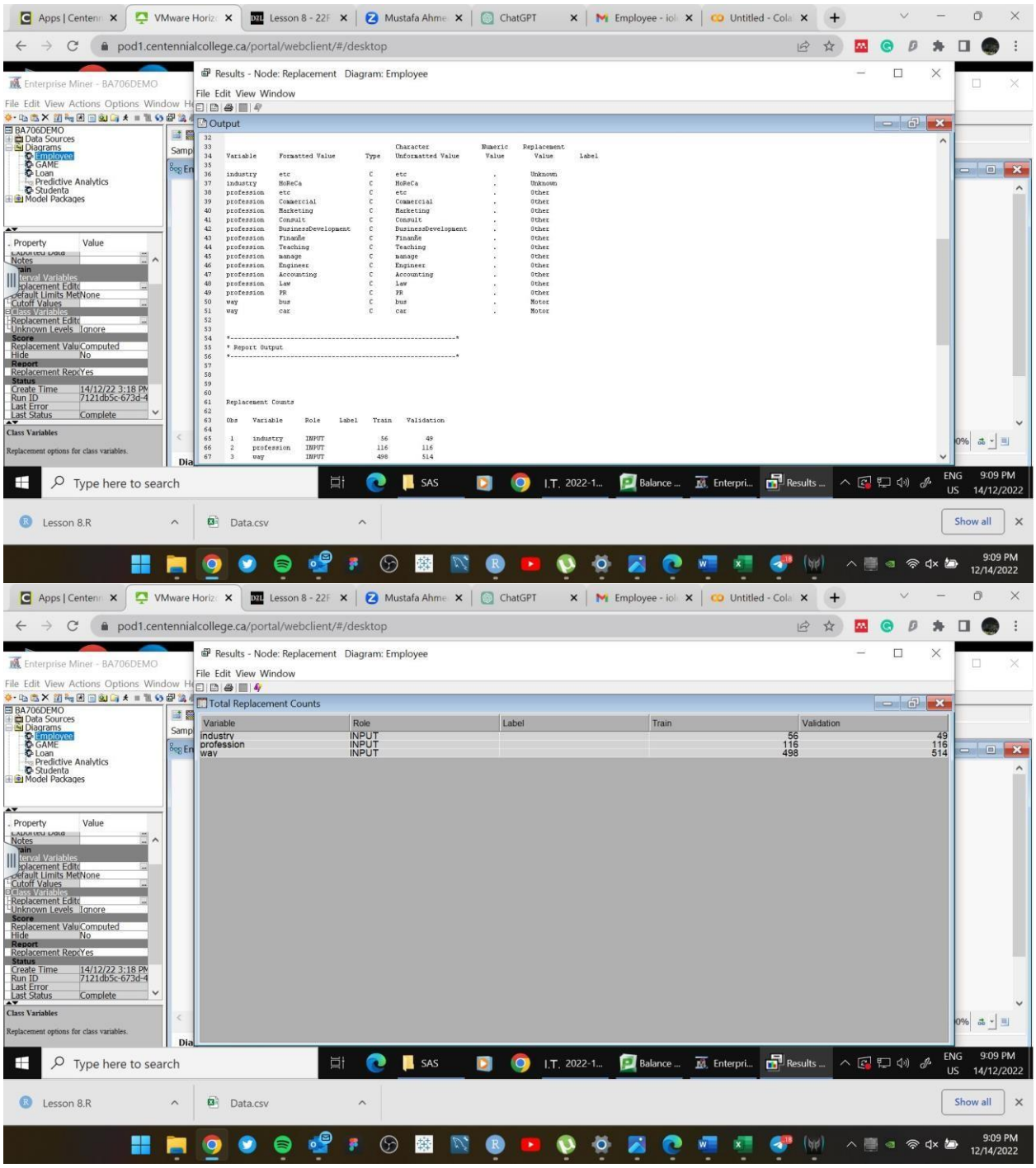
In logistic regression models, encoding all of the independent variables as dummy variables allows easy interpretation and increases the stability and significance of the coefficients.

Therefore we made the Industry variables **HoReca and etc** 'unknown' because we do not know what they are.



And we combined all the industry variables except for HR, IT and Sales and named it 'Other'. We also combined the Profession variables BUS and Car and named it 'Motor'.


Replacement Editor-WORK.OUTCLASS
Variable
Formatted Value
Replacement Value
Frequency Count
Type
Character Unformatted Value
Numeric Value
industry _UNKNOWN_ _DEFAULT_ . C .
profession HR 377 C HR .
profession IT 40 C IT .
profession Sales 31 C Sales .
profession etc Other 22 C etc .
profession Commercial Other 14 C Commercial .
profession Marketing Other 14 C Marketing .
profession Consult Other 13 C Consult .
profession BusinessDevelopment Other 12 C BusinessDevelopment .
profession Finanñe Other 8 C Finanñe .
profession Teaching Other 8 C Teaching .
profession manage Other 8 C manage .
profession Engineer Other 7 C Engineer .
profession Accounting Other 4 C Accounting .
profession Law Other 4 C Law .
profession PR Other 2 C PR .
profession _UNKNOWN_ _DEFAULT_ . C .
way bus Motor 341 C bus .
way car Motor 157 C car .
way foot 66 C foot .
way _UNKNOWN_ _DEFAULT_ . C .
OK
Cancel
Enterprise Miner - BA706DEMO
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Class Variables
Replacement Editor
Unknown Levels Ignore
Score
Report
Status
Create Time 14/12/22 3:18 PM
Run ID 7121db5c-673d-4
Last Error
Last Status Complete
Class Variables
Replacement options for class variables.
Type here to search
SAS
I.T. 2022-12-0...
Balance for ...
Enterprise ...
ENG US
9:07 PM 14/12/2022
Lesson 8.R
Data.csv
Show all
9:07 PM 12/14/2022



Dummy variables, which are useful in regression analysis, use the values 0 or 1 to represent the absence or existence of any categorical effect that would be anticipated to shift the outcome. So, now we can begin building our regression models.

REGRESSION

As stated earlier, there were no missing values so we did not need to connect the impute node.

Therefore, we are going into regression. We first created :

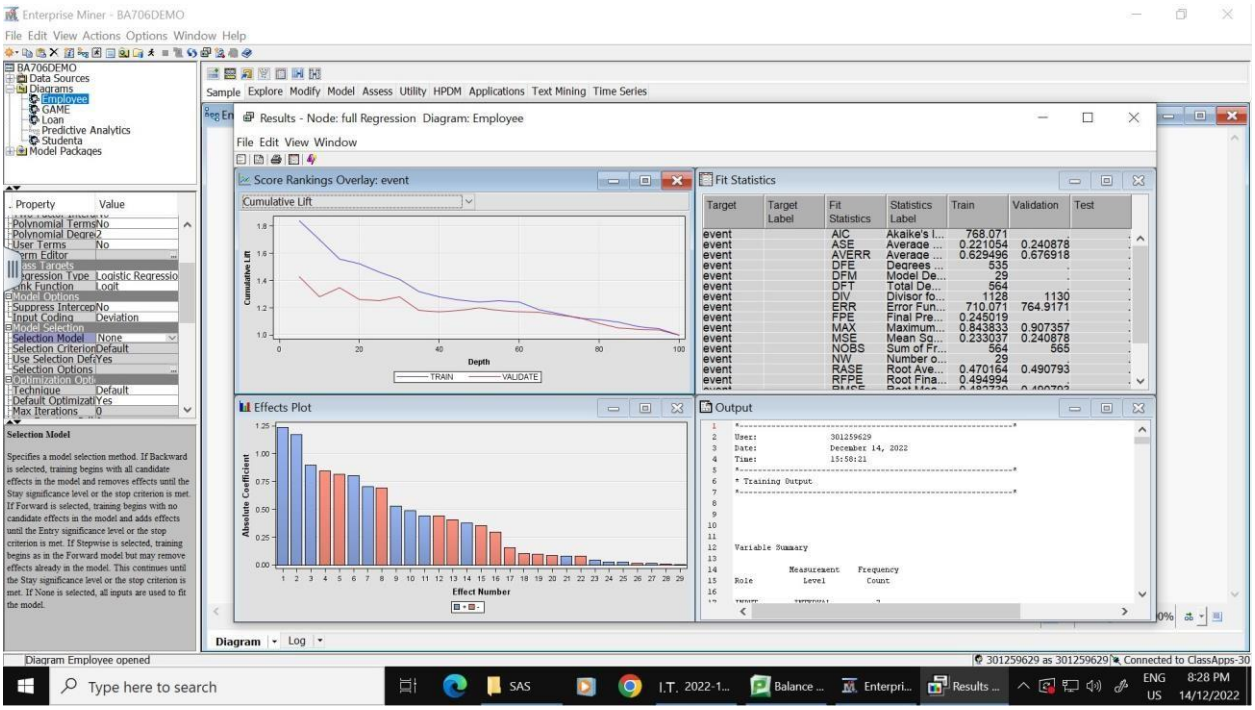
FULL REGRESSION

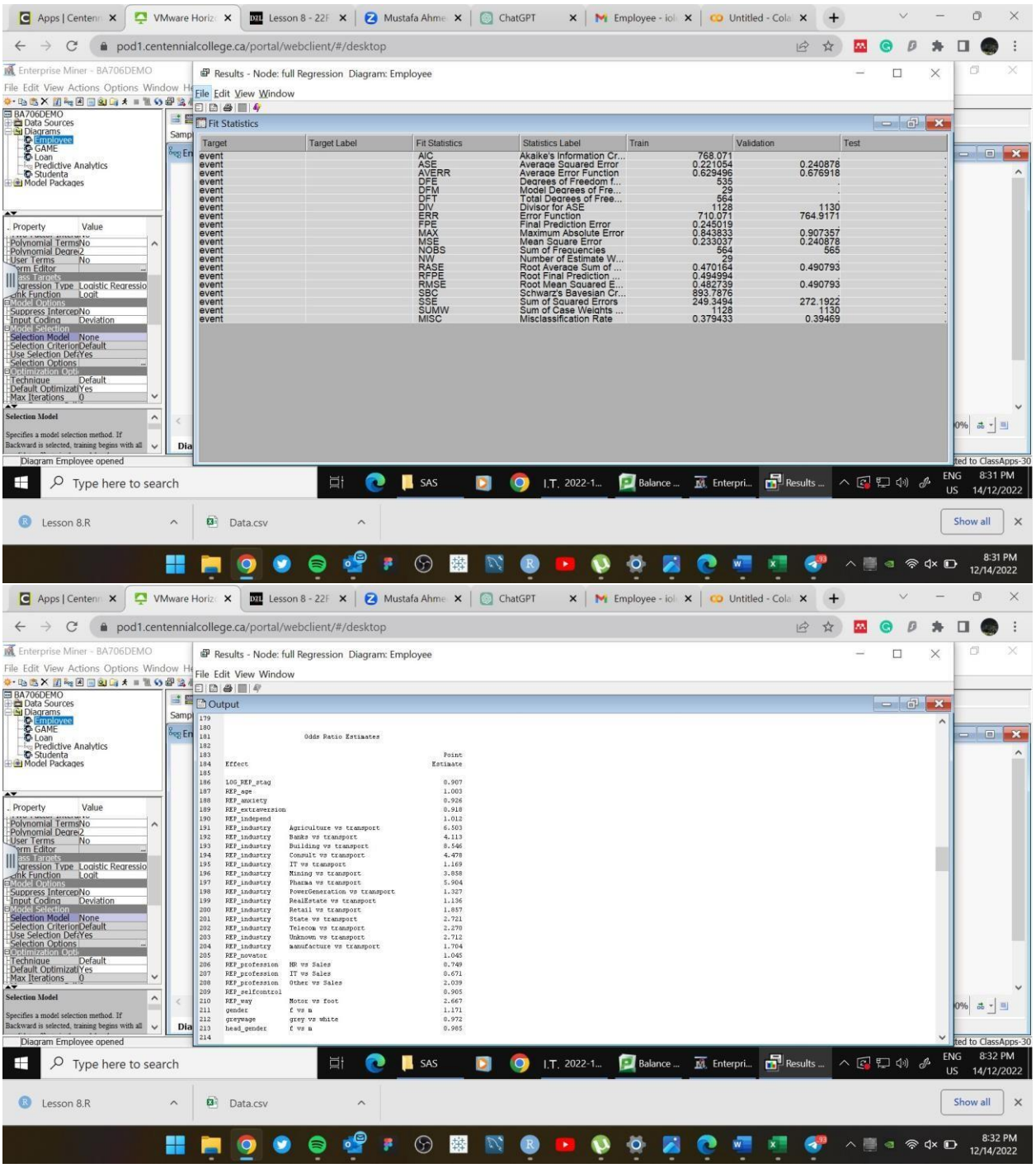
And in other to optimize complexity, we also created:

FORWARD REGRESSION STEPWISE REGRESSION BACKWARD REGRESSION

FULL REGRESSION

The full regression used 28 variables to run the model. The average squared error is 0.240878





Interpretation of Full Regression

Variables		point Estimate	**When compared with the Transport industry**

REP_industry	Building vs transport	8.546	Employees in the Building industry are 8.5 times more to quit.
REP_industry	Agric vs transport	6.503	Employees in the Agriculture Industry are 6.5 times more likely to quit.
REP_industry	pharma vs transport	5.904	Employees in the Pharmacy industry are 5.9 times more likely to quit.
REP_industry	Consult vs transport	4.478	Employees in the Consult industry are 4.5 times more likely to quit.
REP_industry	Banks vs transport	4.113	Employees in the Bank industry are 4.1 times more likely to quit.
REP_industry	Mining vs transport	3.858	Employees in the Mining industry are 3.9 times more likely to quit.
REP_industry	State vs transport	2.721	Employees in the State industry are 2.7 times more likely to quit.

REP_industry	Unknown vs transport	2.712	Employees in the Unknown industry are 2.7 times more likely to quit.
REP_industry	Telecom vs transport	2.270	Employees in the Telecom industry are 2.3 times more to quit.
REP_industry	Retail vs transport	1.857	Employees in the Retail industry are 85.7% more likely to quit.
REP _industry	Manufacture vs transport	1.704	Employees in the Manufacture industry are 70.4% more likely to quit.
REP_industry	PowerGen vs transport	1.327	Employees in the PowerGen industry are 32.7%more likely to quit.

REP_industry	IT vs transport	1.169	Employees in the IT industry are 16.9% more likely to quit.
REP_industry	RealEstate vs transport	1.136	Employees in the Real Estate industry are 13.6% more likely to quit.
			When compared with Sales Profession
REP_profession	Other vs Sales	2.039	Employees in other professions besides HR and IT are more likely to quit
REP_profession	HR vs Sales	0.749	Employees in HR are 25.1% less likely to quit.

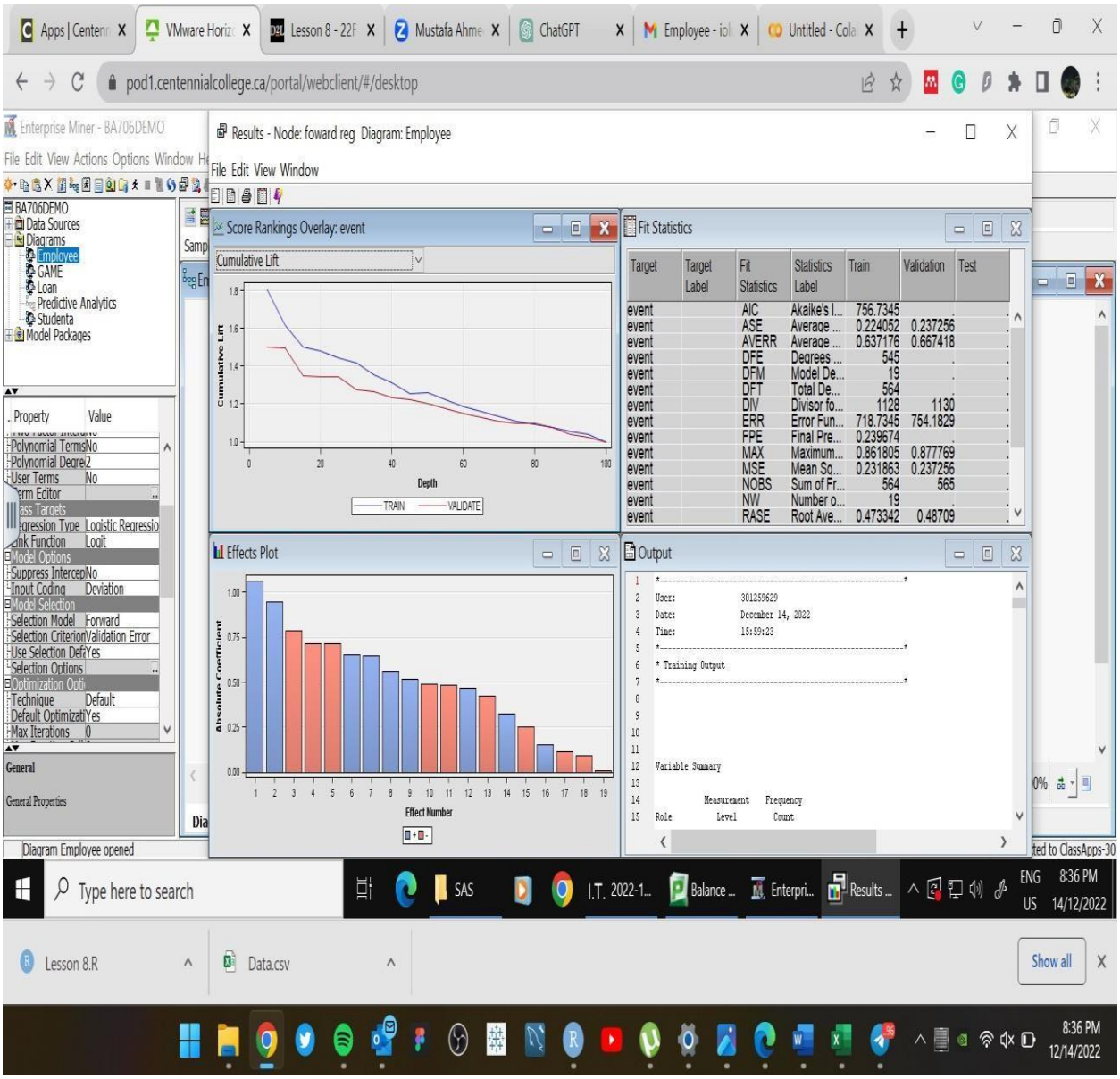
REP_profession	IT vs Sales	0.671	Employees in IT are 32.9% less likely to quit.
			Other Variables
REP_way	Motor vs foot	2.667	Employees who come by Motor are 2.7 times more likely quit than those who come by foot
gender	f vs m	1.171	Female employees are 17.1% more likely to quit than male employees
REP_novator		1.045	For each 1 score the odds of quitting changed by a factor 1.045, a 4.5% increase
lependen		1.012	For each 1 score the odds of quitting changed by a factor of 1.012, a 1.2% increase

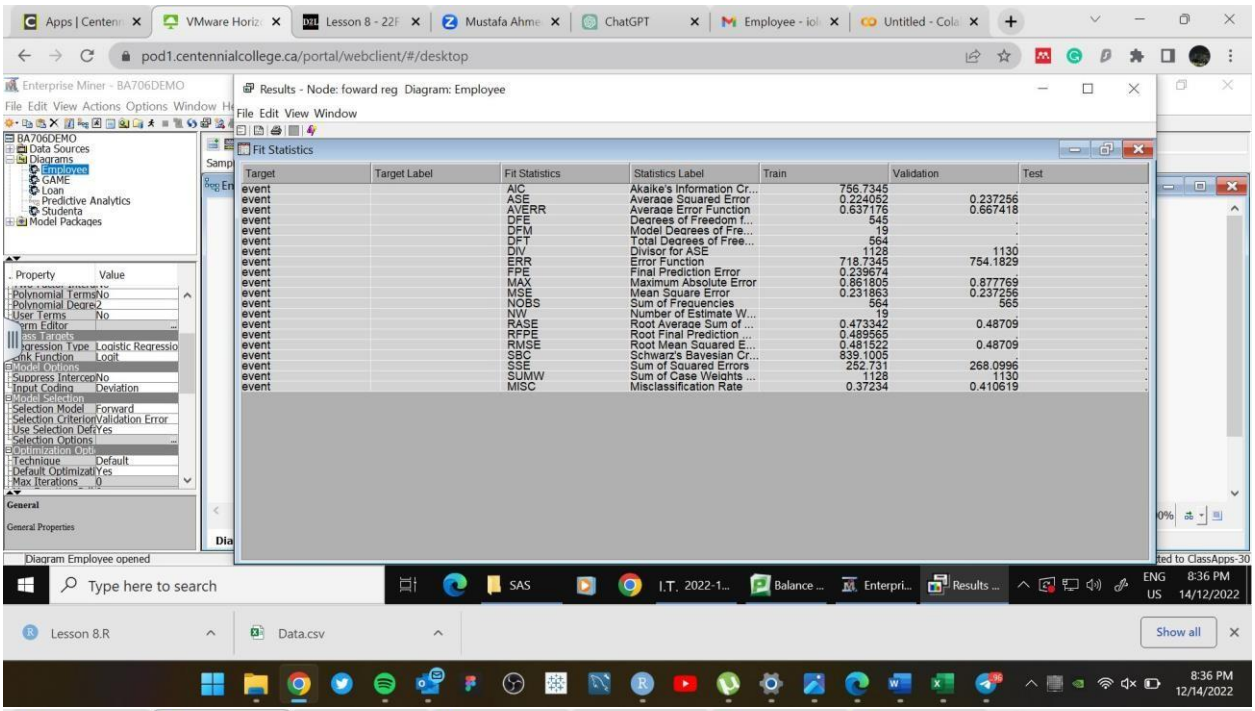
REP_age		1.003	For every year added in age, employees are 0.3% more quit
head_gender	f vs m	0.985	Female supervisor is 2% less likely to quit than a male supervisor
greywage	grey vs white	0.972	Employees who earn above minimum wage are 2.8% less likely to quit than those who earn minimum wage
REP_anxiety		0.926	For each 1 score the odds of quitting changed by a factor of 0.926, a 7.4% decrease
raversion		0.918	For each 1 score the odds of quitting changed by a factor of 0.918, a 8.2% decrease
LOG_REP_stag		0.907	For each 1 score the odds of quitting changed by a factor of 0.907, a 9.3% decrease
REP_selfcontrol		0.905	For each 1 score the odds of quitting changed by a factor of 0.905, a 9.5% decrease

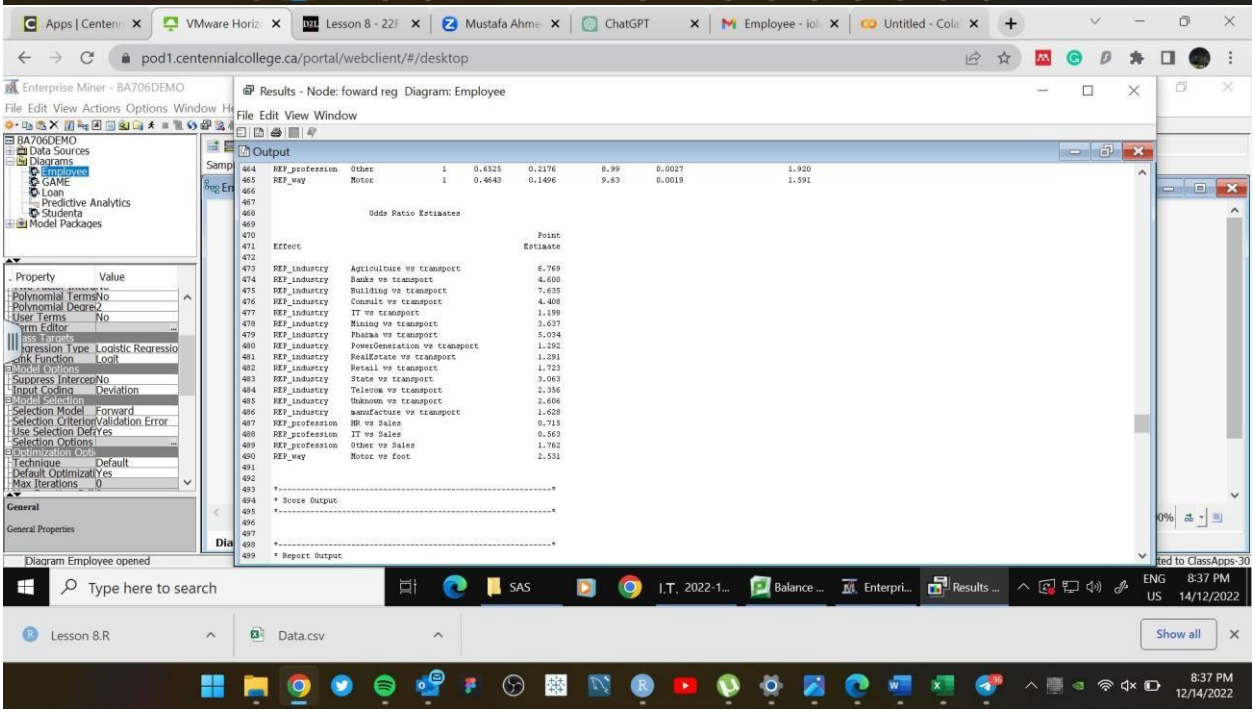
FORWARD REGRESSION

The forward regression used 18 variables to build the model and the outcome is an ASE of 0.237256 which is a better result than the full regression.

The gender of the employee or supervisor, self control score , anxiety score, all other scores, wage level, and experience were not considered significant in building this model.


Apps | Centenn
VMware Horiz
Lesson 8 - 22F
Mustafa Ahme
ChatGPT
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window H
Results - Node: foward reg Diagram: Employee
File Edit View Window
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Property
Value
Polynomial Terms No
Polynomial Degree 2
User Terms No
Model Options
Suppress Interce No
Input Coding Deviation
Model Selection
Selection Model Forward
Selection Criterion Validation Error
Use Selection Defi Yes
Optimization Opti
Technique Default
Default Optimizati Yes
Max Iterations 0
General
General Properties
Score Rankings Overlay: event
Cumulative Lift
Cumulative Lift
Depth
TRAIN
VALIDATE
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event AIC Akaike's I... 756.7345 .
event ASE Average ... 0.224052 0.237256
event AVERR Average ... 0.637176 0.667418
event DFE Degrees ... 545 .
event DFM Model De... 19 .
event DFT Total De... 564 .
event DIV Divisor fo... 1128 1130
event ERR Error Fun... 718.7345 754.1829
event FPE Final Pre... 0.239674 .
event MAX Maximum... 0.861805 0.877769
event MSE Mean Sq... 0.231863 0.237256
event NOBS Sum of Fr... 564 565
event NW Number o... 19 .
event RASE Root Ave... 0.473342 0.48709
Effects Plot
Absolute Coefficient
Effect Number
Output
User: 301259629
Date: December 14, 2022
Time: 15:59:23
* Training Output
Variable Summary
Measurement Frequency
Role Level Count
Diagram Employee opened
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
8:36 PM 14/12/2022
Lesson 8.R
Data.csv
Show all
8:36 PM 12/14/2022


Results - Node: foward reg Diagram: Employee
File Edit View Window
Fit Statistics
Target | Target Label | Fit Statistics | Statistics Label | Train | Validation | Test
event | | AIC | Akaike's Information Cr... | 756.7345 | |
event | | ASE | Average Squared Error | 0.224052 | 0.237256 |
event | | AVERR | Average Error Function | 0.637176 | 0.667418 |
event | | DFE | Degrees of Freedom f... | 545 | |
event | | DFM | Model Degrees of Fre... | 19 | |
event | | DFT | Total Degrees of Free... | 564 | |
event | | DIV | Divisor for ASE | 1128 | 1130 |
event | | ERR | Error Function | 718.7345 | 754.1829 |
event | | FPE | Final Prediction Error | 0.239674 | |
event | | MAX | Maximum Absolute Error | 0.861805 | 0.877769 |
event | | MSE | Mean Square Error | 0.231863 | 0.237256 |
event | | NOBS | Sum of Frequencies | 564 | 565 |
event | | NW | Number of Estimate W... | 19 | |
event | | RASE | Root Average Sum of ... | 0.473342 | 0.48709 |
event | | RFPE | Root Final Prediction ... | 0.489565 | |
event | | RMSE | Root Mean Squared E... | 0.481522 | 0.48709 |
event | | SBC | Schwarz's Bayesian Cr... | 839.1005 | |
event | | SSE | Sum of Squared Errors | 252.731 | 268.0996 |
event | | SUMW | Sum of Case Weights ... | 1128 | 1130 |
event | | MISC | Misclassification Rate | 0.37234 | 0.410619 |
Diagram Employee opened
Lesson 8.R
Data.csv
Show all
8:36 PM
12/14/2022


Results - Node: foward reg Diagram: Employee
File Edit View Window
Output
Odds Ratio Estimates
Point
Effect Estimate
REP_industry Agriculture vs transport 6.769
REP_industry Banks vs transport 4.600
REP_industry Building vs transport 7.635
REP_industry Consult vs transport 4.408
REP_industry IT vs transport 1.198
REP_industry Mining vs transport 3.637
REP_industry Pharma vs transport 5.034
REP_industry PowerGeneration vs transport 1.292
REP_industry RealEstate vs transport 1.291
REP_industry Retail vs transport 1.723
REP_industry State vs transport 3.063
REP_industry Telecom vs transport 2.356
REP_industry Unknown vs transport 2.606
REP_industry manufacture vs transport 1.628
REP_profession HR vs Sales 0.715
REP_profession IT vs Sales 0.563
REP_profession Other vs Sales 1.762
REP_way Motor vs foot 2.531
* Score Output
* Report Output
Diagram Employee opened
Lesson 8.R
Data.csv
Show all
8:37 PM
12/14/2022

Interpretation of Forward Regression

		PoinT Estimate	When compared with the Transport industry
REP_industry	Building vs transport	7.635	Employees in the Building industry are 7.6 times more likely to quit.
REP_industry	Agric vs transport	6.769	Employees in the Agriculture industry are 6.8 times more likely to quit.
REP_industry	Pharma vs transport	5.034	Employees in the Pharmaceutical industry are 5 times more likely to quit.
REP_industry	Banks vs transport	4.600	Employees in the Banking industry are 4.6 times more likely to quit.

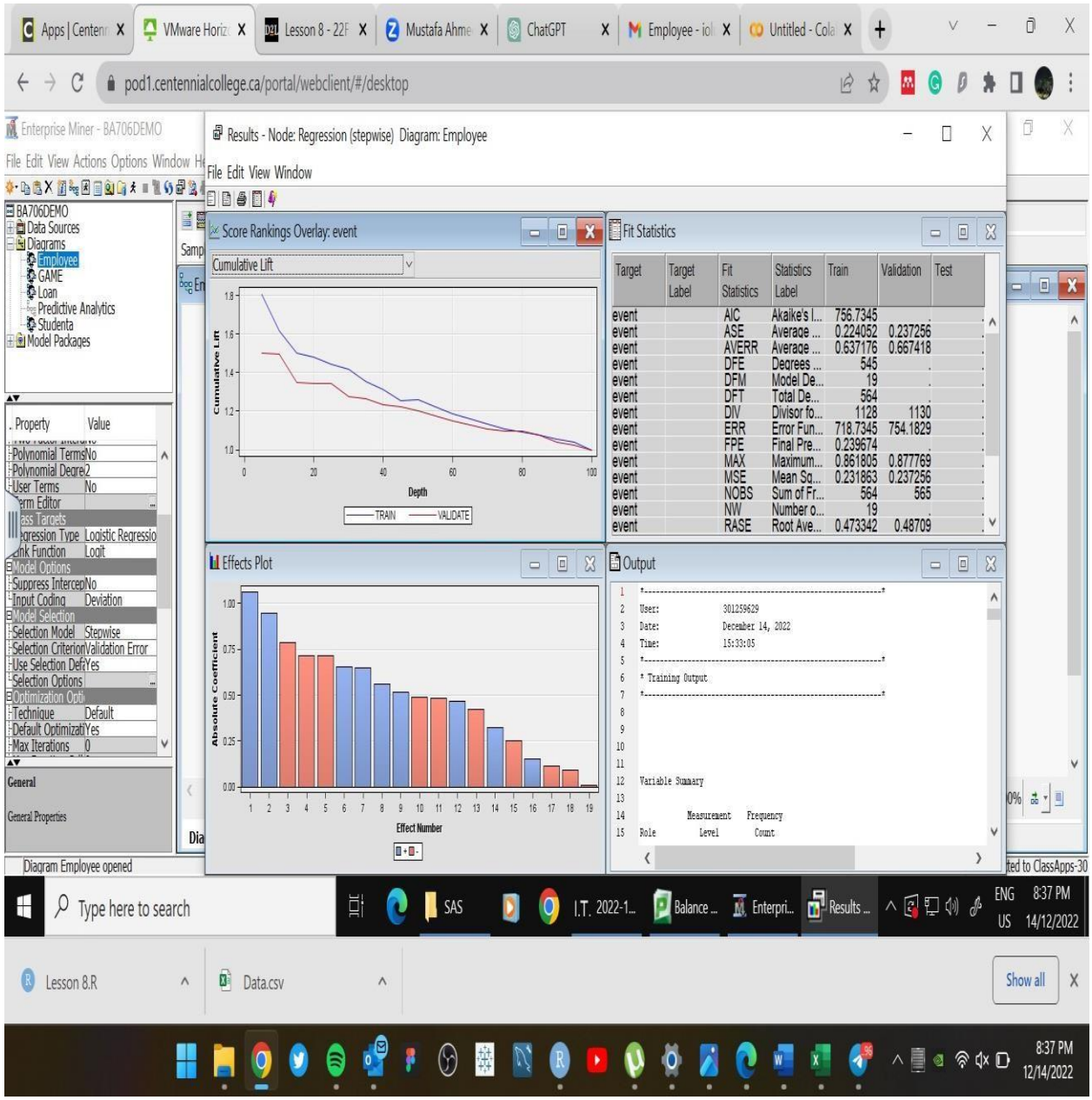
REP_industry	Consult vs transport	4.408	Employees in the Consulting industry are 4.4 times more likely to quit.
REP_industry	Mining vs transport	3.637	Employees in the Mining industry are 3.6 times more likely to quit.
REP_industry	State vs transport	3.063	Employees in the State industry are 3 times more likely to quit.
REP_industry	Unknown vs transport	2.606	Employees in the all other industries not listed are 2.6 times more likely to quit.
REP_industry	Telecom vs transport	2.356	Employees in the Telecom industry are 2.4% more likely to quit.
REP_industry	Retail vs transport	1.723	Employees in the Retail industry are 72.3% more likely to quit.
			Employees in the Manufacture industry are 62.8% more likely to quit.

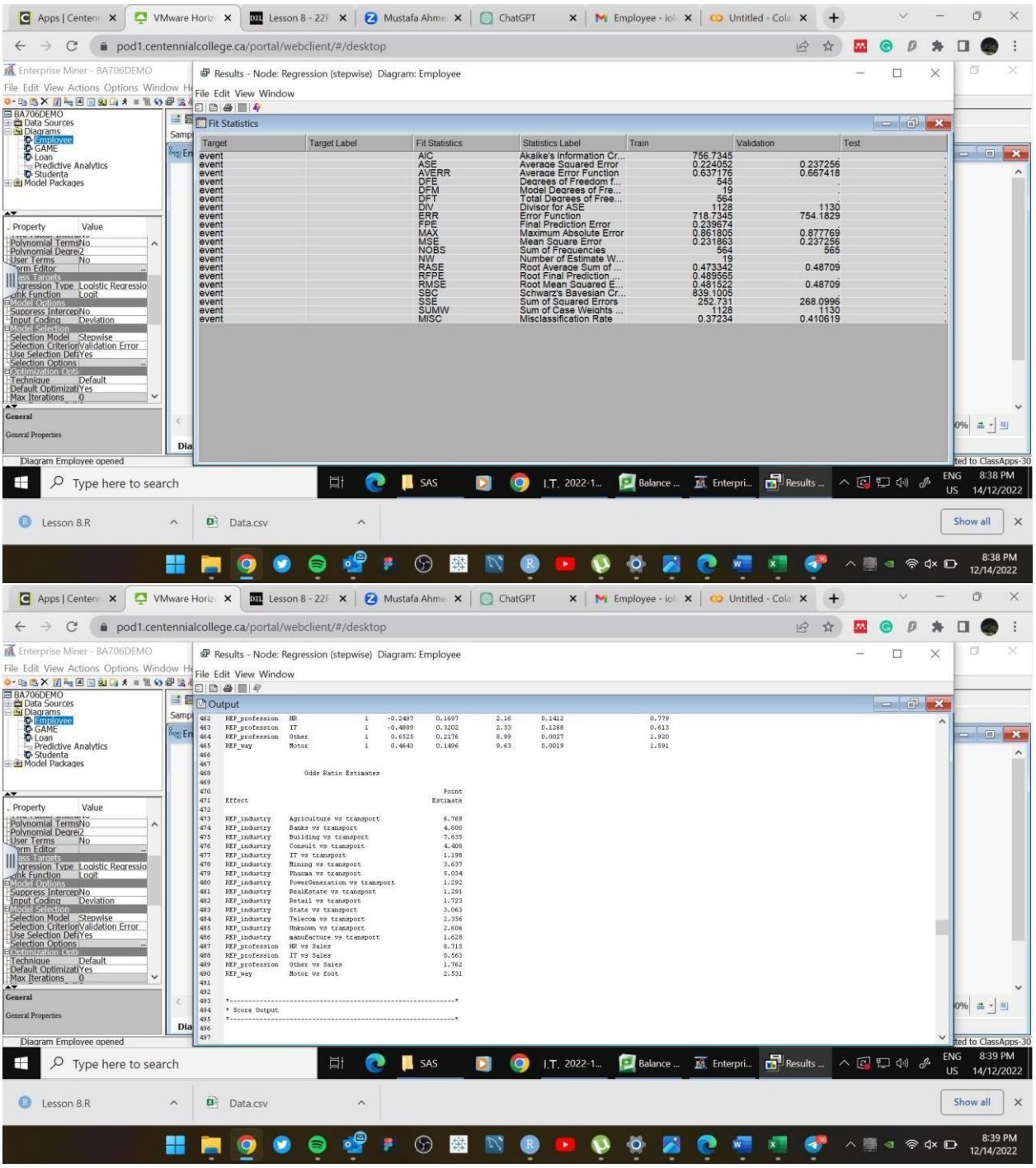
REP_industry	Manufacture vs transport	1.628	
REP_industry	PowerGen vs sport	1.292	Employees in the Power generating industry are 29.2% times more likely to quit.
REP_industry	RealEstate vs transport	1.291	Employees in the Real Estate industry are 29.1% times more likely to quit.
REP_industry	IT vs transport	0.880	Employees in the IT industry are 12% less likely to quit.
			When compared with Sales Profession
REP_profession	r vs Sales	1.762	Employees in professions other than HR and IT are 76% more likely to quit
REP_profession	HR vs Sales	0.715	Employees in HR are 28.5% less likely to quit
REP_profession	IT vs Sales	0.563	Employees in IT are 43.7% less likely to quit
			Other Variables

REP_way	Motor vs foot	2.531	loyees who go to the office with a vehicle are 2.5 times more likely to quit than those who walk to the office.

STEPWISE REGRESSION

The stepwise model also used 18 variables and had the same outcome as the forward regression with an ASE of 0.237256.


Apps | Centenn
VMware Horiz
Lesson 8 - 22F
Mustafa Ahme
ChatGPT
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window He
Results - Node: Regression (stepwise) Diagram: Employee
File Edit View Window
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Property
Value
Polynomial Terms No
Polynomial Degre 2
User Terms No
Model Options
Suppress Intercep No
Input Coding Deviation
Model Selection
Selection Model Stepwise
Selection Criterion Validation Error
Use Selection Defa Yes
Selection Options
Optimization Opti
Technique Default
Default Optimizati Yes
Max Iterations 0
General
General Properties
Score Rankings Overlay: event
Cumulative Lift
Cumulative Lift
Depth
TRAIN
VALIDATE
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event AIC Akaike's I... 756.7345 .
event ASE Average ... 0.224052 0.237256
event AVERR Average ... 0.637176 0.667418
event DFE Degrees ... 545 .
event DFM Model De... 19 .
event DFT Total De... 564 .
event DIV Divisor fo... 1128 1130
event ERR Error Fun... 718.7345 754.1829
event FPE Final Pre... 0.239674 .
event MAX Maximum... 0.861805 0.877769
event MSE Mean Sq... 0.231863 0.237256
event NOBS Sum of Fr... 564 565
event NW Number o... 19 .
event RASE Root Ave... 0.473342 0.48709
Effects Plot
Absolute Coefficient
Effect Number
Output
User: 301259629
Date: December 14, 2022
Time: 15:33:05
* Training Output
Variable Summary
Role Measurement Level Frequency Count
Diagram Employee opened
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
8:37 PM 14/12/2022
Lesson 8.R
Data.csv
Show all
8:37 PM 12/14/2022



Interpretation of Stepwise Regression

Variables		Point Estimate	When compared to Transport Industry

Rep_Industry	Agriculture vs transport	6.769	Employees in the
			Agriculture industry are 6.8 times more likely to quit
Rep_Industry	Banks vs transport	4.600	Employees in the Bank industry are 4.6 times more likely to quit
Rep_Industry	Building vs transport	7.635	Employees in the Building industry are 7.6 times more likely to quit
Rep_Industry	Consult vs transport	4.408	Employees in the Consult industry are 4.4 times more likely to quit
Rep_Industry	IT vs transport	1.198	Employees in the IT industry are 19.8% more likely to quit
Rep_Industry	Mining vs transport	3.637	Employees in the Mining industry are 3.6 times more likely to quit
Rep_Industry	Pharma vs transport	5.034	Employees in the Pharma industry are 5 times more likely to quit

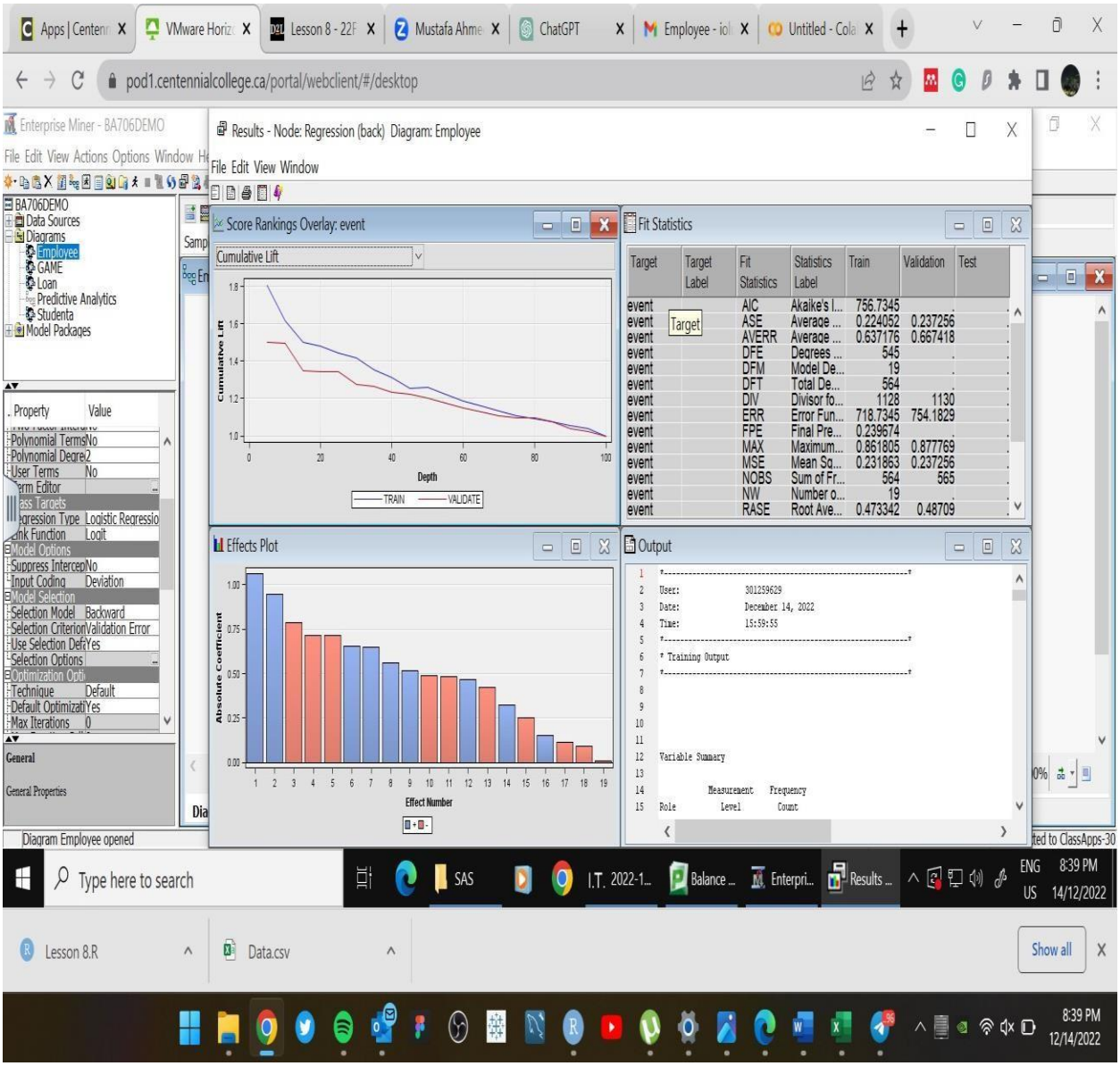
Rep_Industry	Power Generation vs transport	1.292	Employees in the Power Generation industry are 29.2% more likely to quit
Rep_Industry	Real Estate vs transport	1.291	Employees in the Real Estate industry are 29.1% more likely to quit

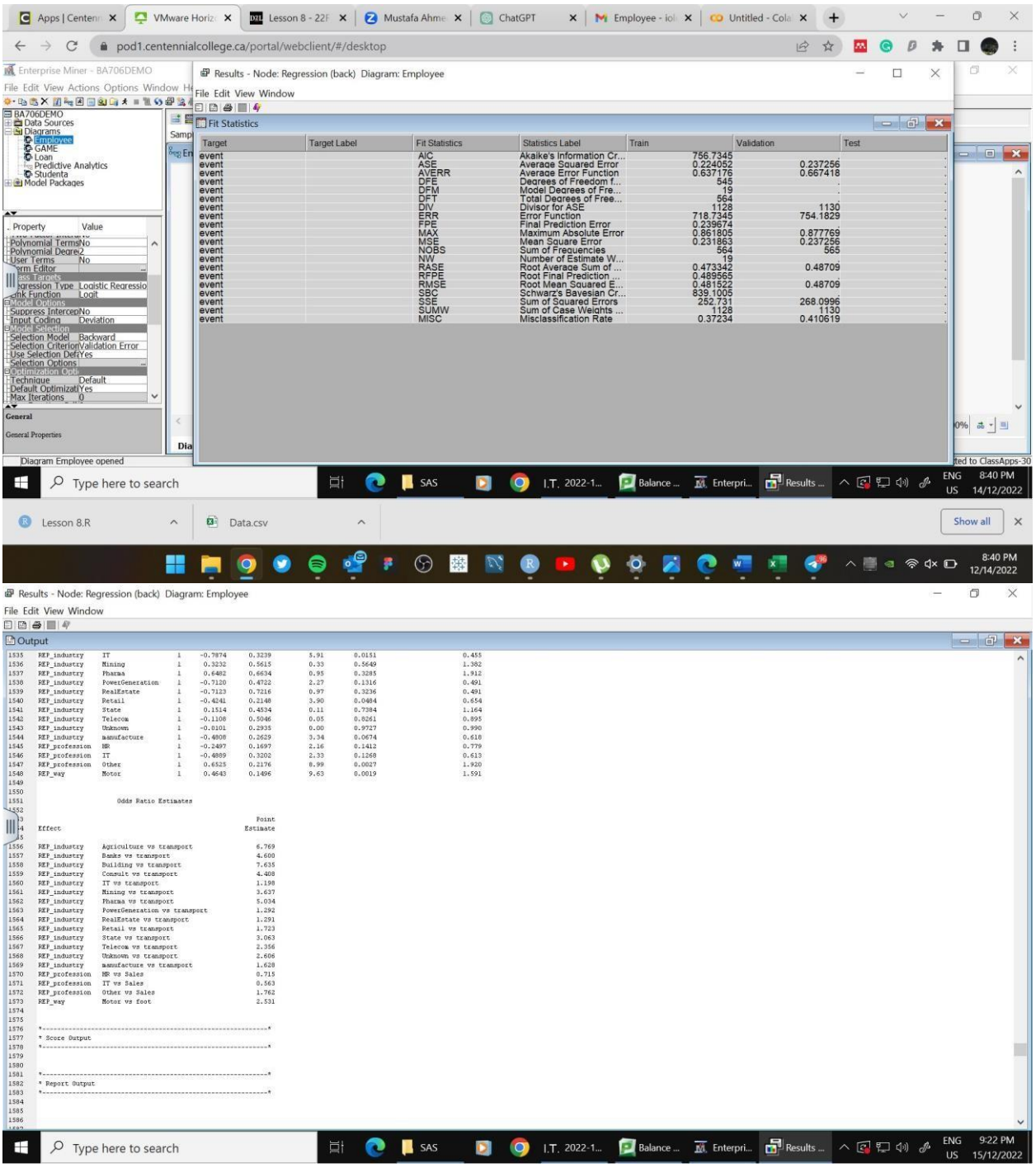
Rep_Industry	Retail vs transport	1.723	Employees in the Retail Industry are 72.3% more likely to quit
Rep_Industry	State vs transport	3.063	Employees in the State industry are 3.1 times more likely to quit
Rep_Industry	Telecom vs transport	2.356	Employees in the Telecom industry are 2.4 times more likely to quit
Rep_Industry	Unknown vs transport	2.606	Employees in the Unknown industry are 2.6 times more likely to quit
Rep_Industry	Manufacture vs transport	1.628	Employees in the Manufacture industry are 62.8% more likely to quit
			When compared with Sales Profession

Rep_Profession	HR vs Sales	0.715	Employees in HR are 28.5% less likely to quit
Rep_Profession	IT vs Sales	0.563	Employees in IT are 43.7% less likely to quit
Rep_Profession	Other vs Sales	1.762	Employees in Other Professions are 76.2% more likely to quit
			Other Variable
Rep_Way	Motor vs Foot	2.531	Employees who come to work by Motor are 2.5 times more likely to quit than those who come by Foot

BACKWARD REGRESSION

The backward regression model also used 18 variables and had the same outcome as the forward regression and stepwise regression with an ASE of 0.237256.


Apps | Centenn
VMware Horiz
Lesson 8 - 22F
Mustafa Ahme
ChatGPT
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window He
Results - Node: Regression (back) Diagram: Employee
File Edit View Window
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Score Rankings Overlay: event
Cumulative Lift
Cumulative Lift
Depth
TRAIN
VALIDATE
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event
AIC
Akaike's I...
756.7345
event
ASE
Average ...
0.224052
0.237256
event
AVERR
Average ...
0.637176
0.667418
event
DFE
Degrees ...
545
event
DFM
Model De...
19
event
DFT
Total De...
564
event
DIV
Divisor fo...
1128
1130
event
ERR
Error Fun...
718.7345
754.1829
event
FPE
Final Pre...
0.239674
event
MAX
Maximum...
0.861805
0.877769
event
MSE
Mean Sq...
0.231863
0.237256
event
NOBS
Sum of Fr...
564
565
event
NW
Number o...
19
event
RASE
Root Ave...
0.473342
0.48709
Effects Plot
Absolute Coefficient
Effect Number
Output
User: 301259629
Date: December 14, 2022
Time: 15:59:55
* Training Output
Variable Summary
Measurement Frequency
Role Level Count
Property
Value
Polynomial Terms No
Polynomial Degree 2
User Terms No
Model Options
Suppress Intercep No
Input Coding Deviation
Model Selection
Selection Model Backward
Selection Criterion Validation Error
Use Selection Defa Yes
Selection Options
Optimization Opti
Technique Default
Default Optimizati Yes
Max Iterations 0
General
General Properties
Diagram Employee opened
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
8:39 PM 14/12/2022
Lesson 8.R
Data.csv
Show all
8:39 PM 12/14/2022


Apps | Centenn
VMware Horiz
Lesson 8 - 22F
Mustafa Ahme
ChatGPT
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window He
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Property
Value
Polynomial Terms
No
Polynomial Degree
2
User Terms
No
Model Options
Suppress Intercep
No
Input Coding
Deviation
Model Selection
Selection Model
Backward
Selection Criterion
Validation Error
Use Selection Defa
Yes
Optimization Opti
Technique
Default
Default Optimizati
Yes
Max Iterations
0
General
General Properties
Diagram Employee opened
Results - Node: Regression (back) Diagram: Employee
File Edit View Window
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event
AIC
Akaike's Information Cr...
756.7345
event
ASE
Average Squared Error
0.224052
0.237256
event
AVERR
Average Error Function
0.637176
0.667418
event
DFE
Degrees of Freedom f...
545
event
DFM
Model Degrees of Fre...
19
event
DFT
Total Degrees of Free...
564
event
DIV
Divisor for ASE
1128
1130
event
ERR
Error Function
718.7345
754.1829
event
FPE
Final Prediction Error
0.239674
event
MAX
Maximum Absolute Error
0.861805
0.877769
event
MSE
Mean Square Error
0.231863
0.237256
event
NOBS
Sum of Frequencies
564
565
event
NW
Number of Estimate W...
19
event
RASE
Root Average Sum of ...
0.473342
0.48709
event
RFPE
Root Final Prediction ...
0.489565
event
RMSE
Root Mean Squared E...
0.481522
0.48709
event
SBC
Schwarz's Bayesian Cr...
839.1005
event
SSE
Sum of Squared Errors
252.731
268.0996
event
SUMW
Sum of Case Weights ...
1128
1130
event
MISC
Misclassification Rate
0.37234
0.410619
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG
US
8:40 PM
14/12/2022
Lesson 8.R
Data.csv
Show all
8:40 PM
12/14/2022
Results - Node: Regression (back) Diagram: Employee
File Edit View Window
Output
1535 REP_industry IT 1 -0.7874 0.3239 5.91 0.0151 0.455
1536 REP_industry Mining 1 0.3232 0.5615 0.33 0.5649 1.382
1537 REP_industry Pharma 1 0.6482 0.6634 0.95 0.3285 1.912
1538 REP_industry PowerGeneration 1 -0.7120 0.4722 2.27 0.1316 0.491
1539 REP_industry RealEstate 1 -0.7123 0.7216 0.97 0.3236 0.491
1540 REP_industry Retail 1 -0.4241 0.2148 3.90 0.0484 0.654
1541 REP_industry State 1 0.1514 0.4574 0.11 0.7384 1.164
1542 REP_industry Telecom 1 -0.1108 0.5046 0.05 0.8261 0.895
1543 REP_industry Unknown 1 -0.0101 0.2935 0.00 0.9727 0.990
1544 REP_industry manufacture 1 -0.4808 0.2629 3.34 0.0674 0.618
1545 REP_profession HR 1 -0.2497 0.1697 2.16 0.1412 0.779
1546 REP_profession IT 1 -0.4889 0.3202 2.33 0.1268 0.613
1547 REP_profession Other 1 0.6525 0.2176 8.99 0.0027 1.920
1548 REP_way Motor 1 0.4643 0.1496 9.63 0.0019 1.591
Odds Ratio Estimates
Effect
Point Estimate
REP_industry Agriculture vs transport 6.769
REP_industry Banks vs transport 4.600
REP_industry Building vs transport 7.635
REP_industry Consult vs transport 4.408
REP_industry IT vs transport 1.198
REP_industry Mining vs transport 3.637
REP_industry Pharma vs transport 5.034
REP_industry PowerGeneration vs transport 1.292
REP_industry RealEstate vs transport 1.291
REP_industry Retail vs transport 1.723
REP_industry State vs transport 3.063
REP_industry Telecom vs transport 2.356
REP_industry Unknown vs transport 2.606
REP_industry manufacture vs transport 1.628
REP_profession HR vs Sales 0.715
REP_profession IT vs Sales 0.563
REP_profession Other vs Sales 1.762
REP_way Motor vs foot 2.531
* Score Output
* Report Output
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG
US
9:22 PM
15/12/2022

Interpretation of Backward Regression

Variables		**Point Estimate**	**When compared to Transport Industry**
Rep_Industry	Agriculture vs transport	6.769	Employees in the Agriculture industry are 6.8 times more likely to quit
Rep_Industry	Banks vs transport	4.600	Employees in the Bank industry are 4.6 times more likely to quit
Rep_Industry	Building vs transport	7.635	Employees in the Building industry are 7.6 times more likely to quit
Rep_Industry	Consult vs transport	4.408	Employees in the Consult industry are 4.4 times more likely to quit
Rep_Industry	IT vs transport	1.198	Employees in the IT industry are 19.8% more likely to quit
Rep_Industry	Mining vs transport	3.637	Employees in the Mining industry are 3.6 times more likely to quit

Rep_Industry	Pharma vs transport	5.034	Employees in the Pharma industry are 5 times more likely to quit
Rep_Industry	Power Generation vs transport	1.292	Employees in the Power Generation industry are 29.2% more likely to quit

Rep_Industry	Real Estate vs transport	1.291	Employees in the Real Estate industry are 29.1% more likely to quit
Rep_Industry	Retail vs transport	1.723	Employees in the Retail Industry are 72.3% more likely to quit
Rep_Industry	State vs transport	3.063	Employees in the State industry are 3.1 times more likely to quit
Rep_Industry	Telecom vs transport	2.356	Employees in the Telecom industry are 2.4 times more likely to quit
Rep_Industry	Unknown vs transport	2.606	Employees in the Unknown industry are 2.6 times more likely to quit

Rep_Industry	Manufacture vs transport	1.628	Employees in the Manufacture industry are 62.8% more likely to quit
			When compared with Sales Profession
Rep_Profession	HR vs Sales	0.715	Employees in HR are 28.5% less likely to quit
Rep_Profession	IT vs Sales	0.563	Employees in IT are 43.7% less likely to quit
Rep_Profession	Other vs Sales	1.762	Employees in Other Professions are 76.2% more likely to quit
			Other Variable
Rep_Way	Motor vs Foot	2.531	Employees who come to work by Motor are 2.5 times more likely to quit than those who come by Foot

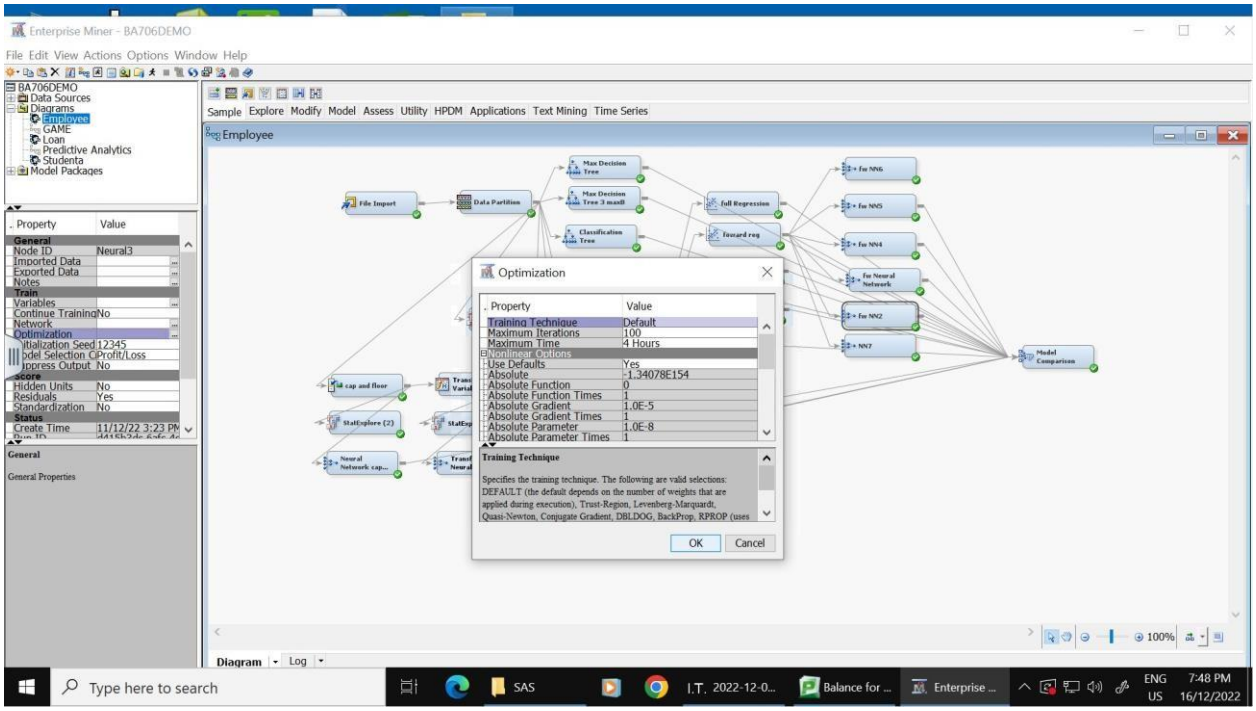
NEURAL NETWORK

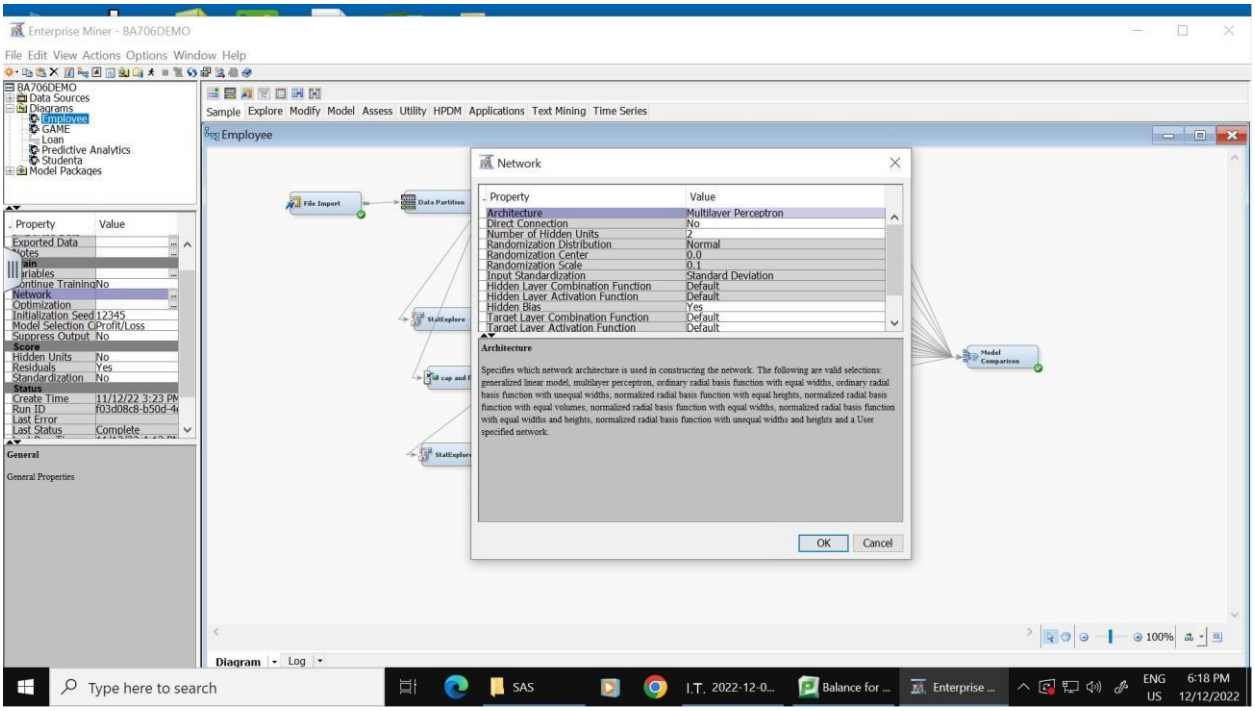
With the full regression having an ASE of 0.240878 and Forward, Stepwise , and Backward regression models all having the same ASE of 0.237256 we have an option of choosing from any of the three with the better average squared error. We chose the Forward regression model because of its additive style of selecting variables.

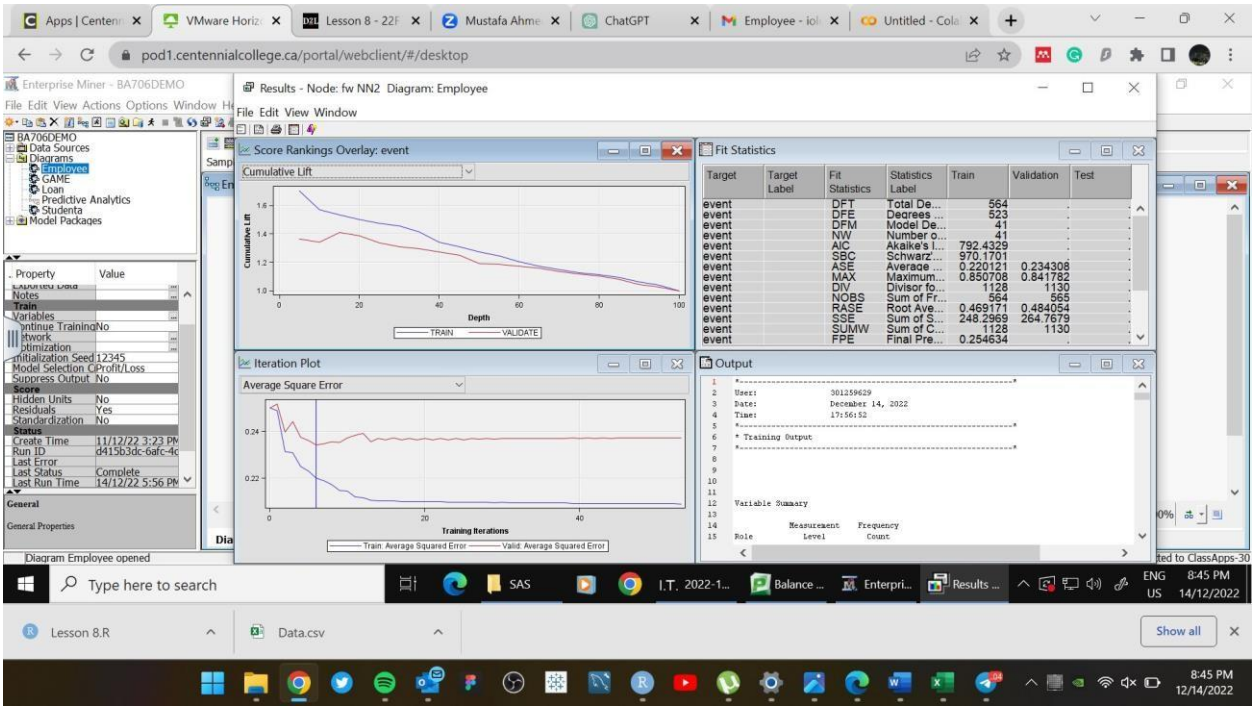
All neural networks were run using 100 iterations, and preliminary training was turned off. The distinguishing factor for all the neural networks run was the number of hidden units used.

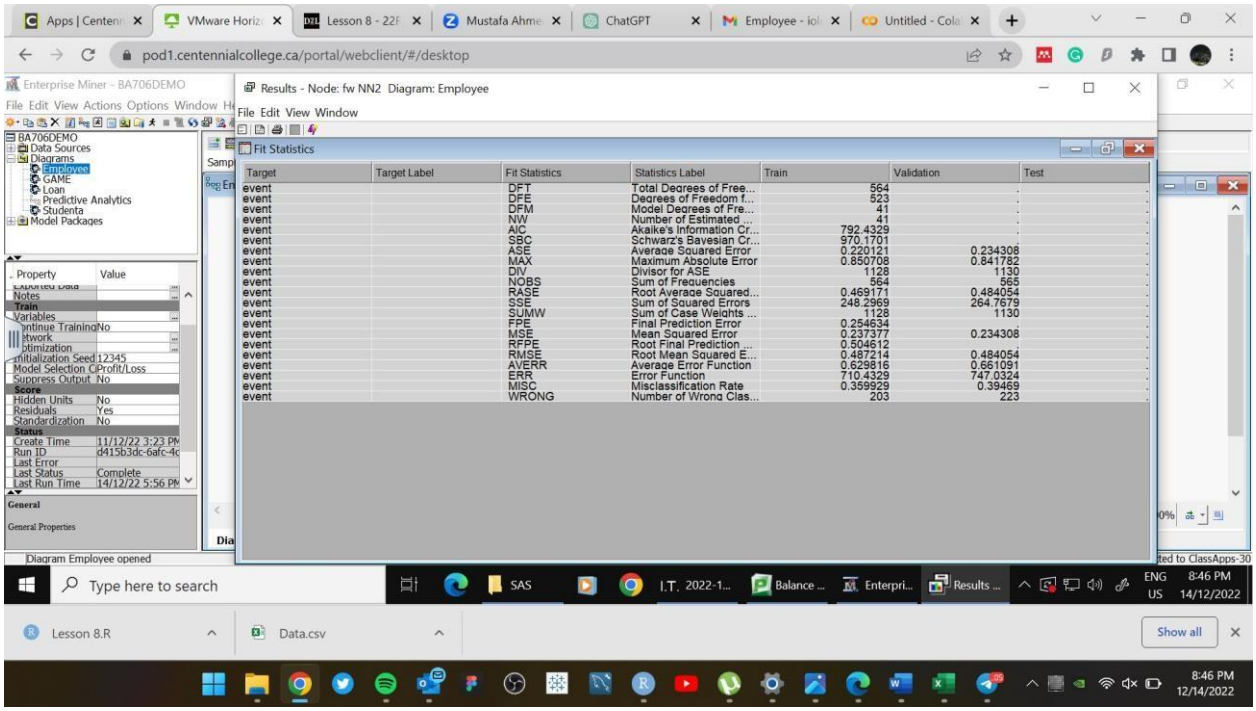
NEURAL NETWORK WITH 2 HIDDEN UNITS

This neural network node was run using two hidden units. The ASE was 0.234308.

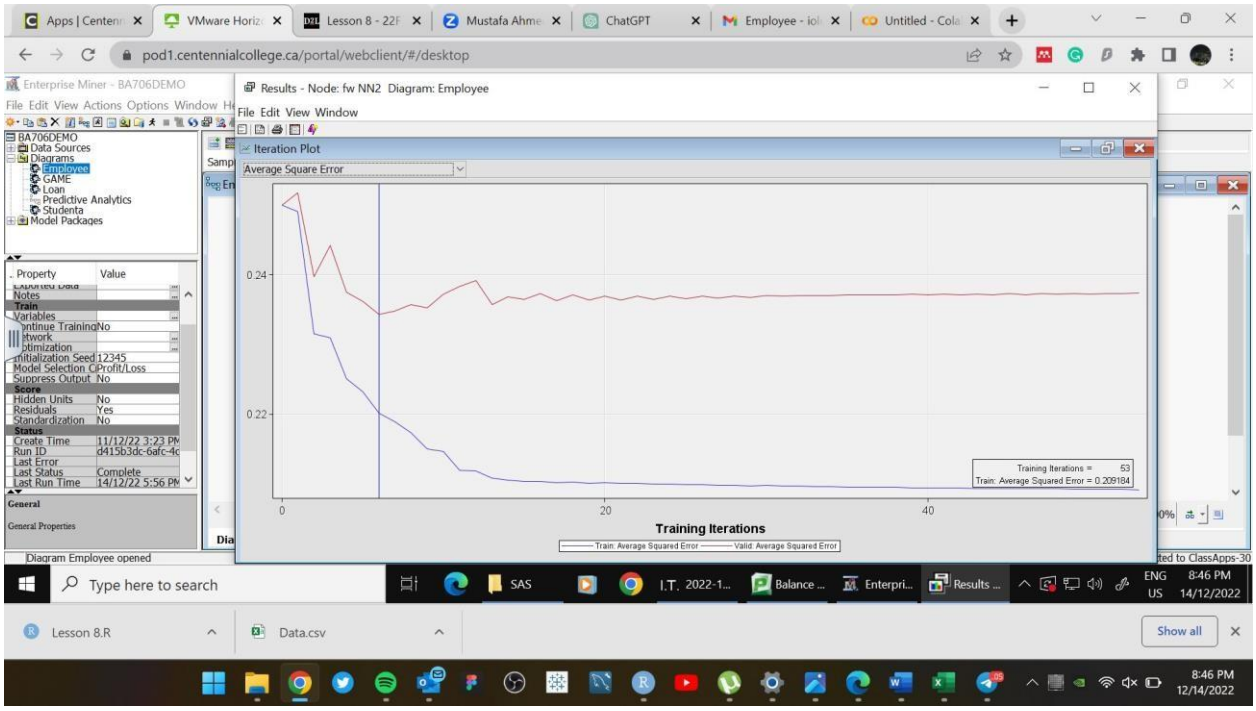



Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Employee
Network
Property
Value
Architecture
Multilayer Perceptron
Direct Connection
No
Number of Hidden Units
2
Randomization Distribution
Normal
Randomization Center
0.0
Randomization Scale
0.1
Input Standardization
Standard Deviation
Hidden Layer Combination Function
Default
Hidden Layer Activation Function
Default
Hidden Bias
Yes
Target Layer Combination Function
Default
Target Layer Activation Function
Default
Architecture
Specifies which network architecture is used in constructing the network. The following are valid selections: generalized linear model, multilayer perceptron, ordinary radial basis function with equal widths, ordinary radial basis function with unequal widths, normalized radial basis function with equal heights, normalized radial basis function with equal volumes, normalized radial basis function with equal widths, normalized radial basis function with equal widths and heights, normalized radial basis function with unequal widths and heights and a User specified network.
OK
Cancel
Diagram
Log
Type here to search
ENG US
6:18 PM
12/12/2022


pod1.centennialcollege.ca/portal/webclient/#/desktop
Results - Node: fw NN2 Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Depth
TRAIN
VALIDATE
Fit Statistics
Iteration Plot
Average Square Error
Training Iterations
Output
Diagram Employee opened
Type here to search
ENG US
8:45 PM
12/14/2022
Lesson 8.R
Data.csv
Show all
8:45 PM
12/14/2022

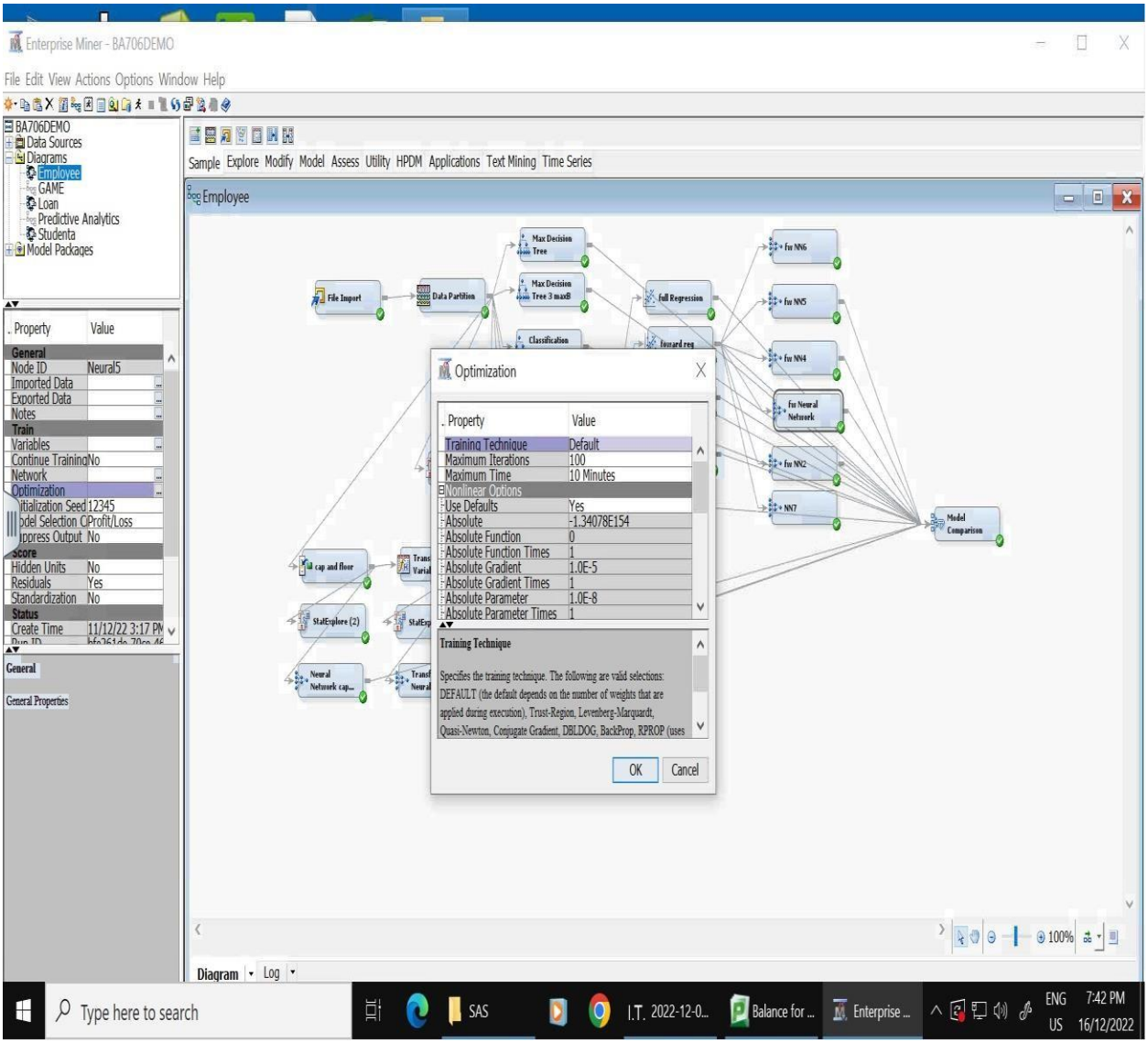


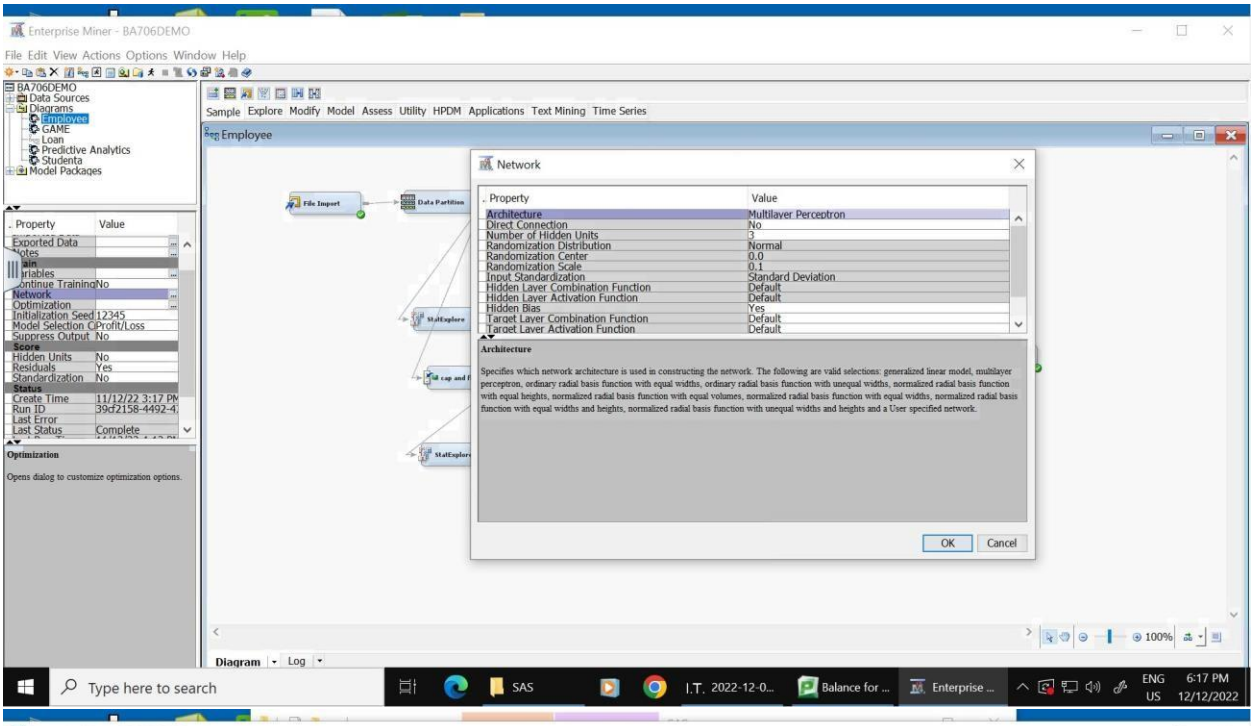
Here, we see that the average squared error of the training and validation data sets start off in opposite directions with the validation getting worse before it changes direction for improvement. The most improvement for the validation ASE was at iteration 6 then a slight increase occurred which is a sign of overfitting. At iteration 53 convergence occurred.

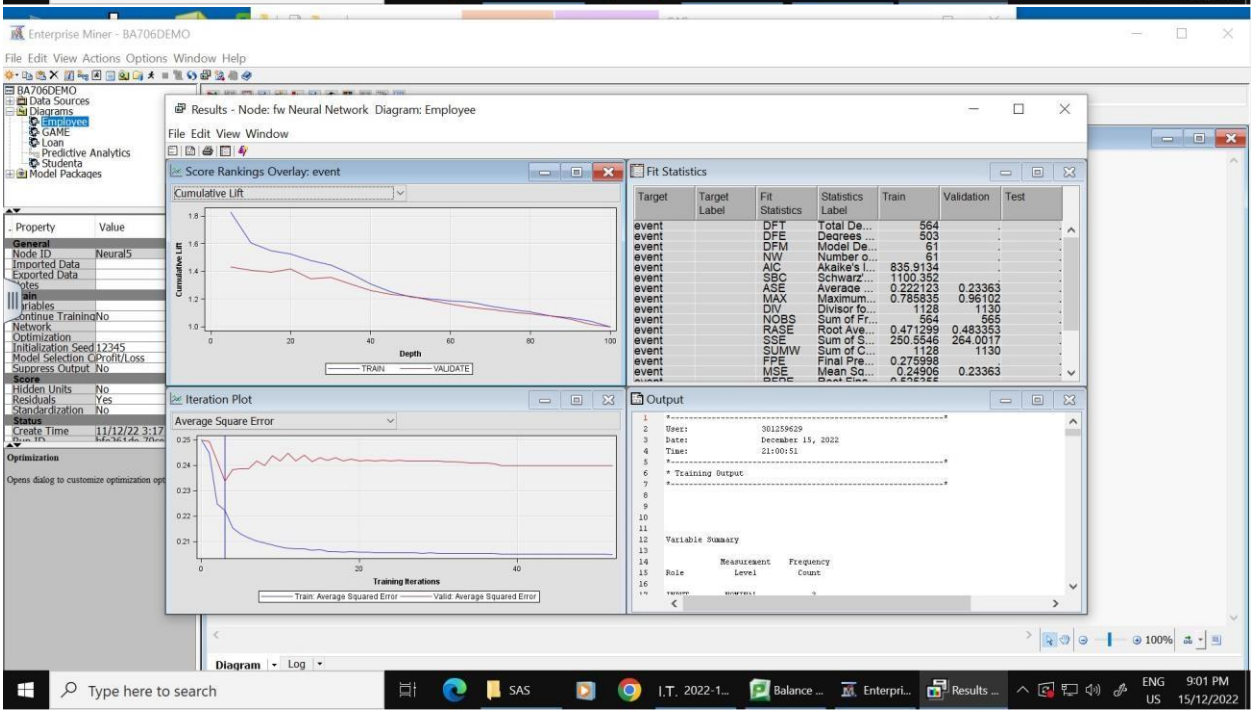


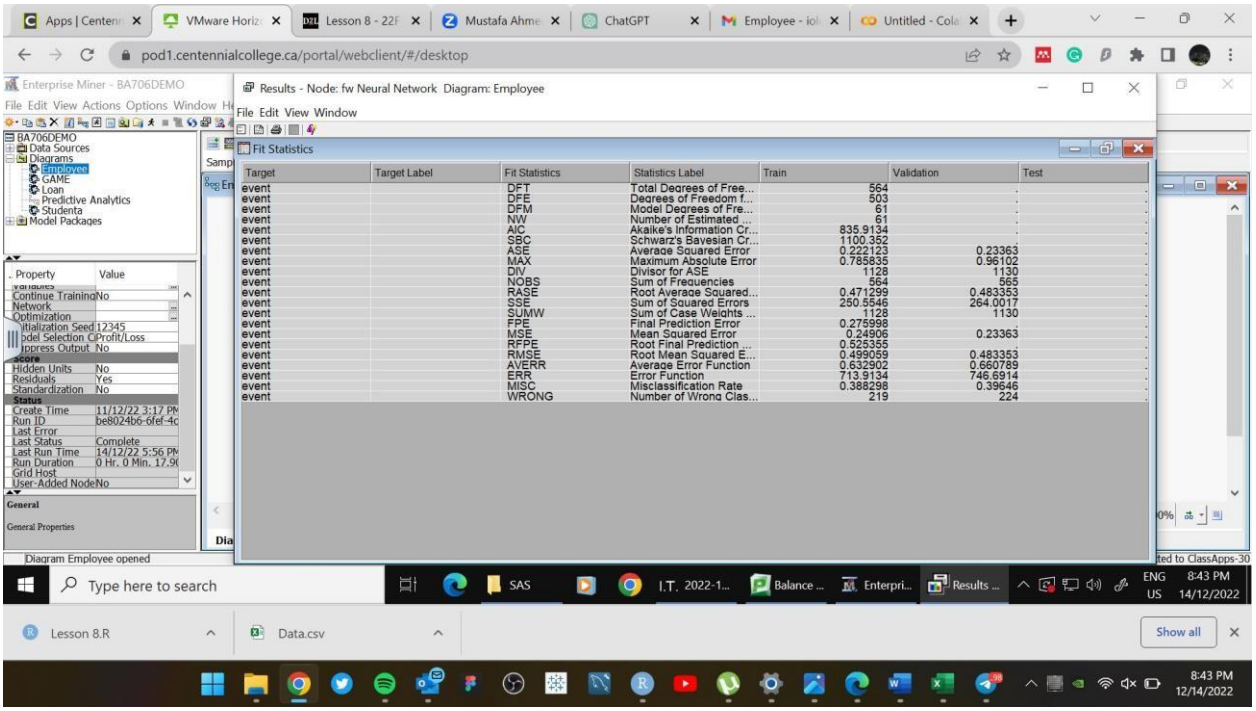
NEURAL NETWORK WITH 3 HIDDEN UNITS

This neural network node was run using three hidden units. The ASE was 0.23363 which is an improvement from the neural network with 2 hidden units.

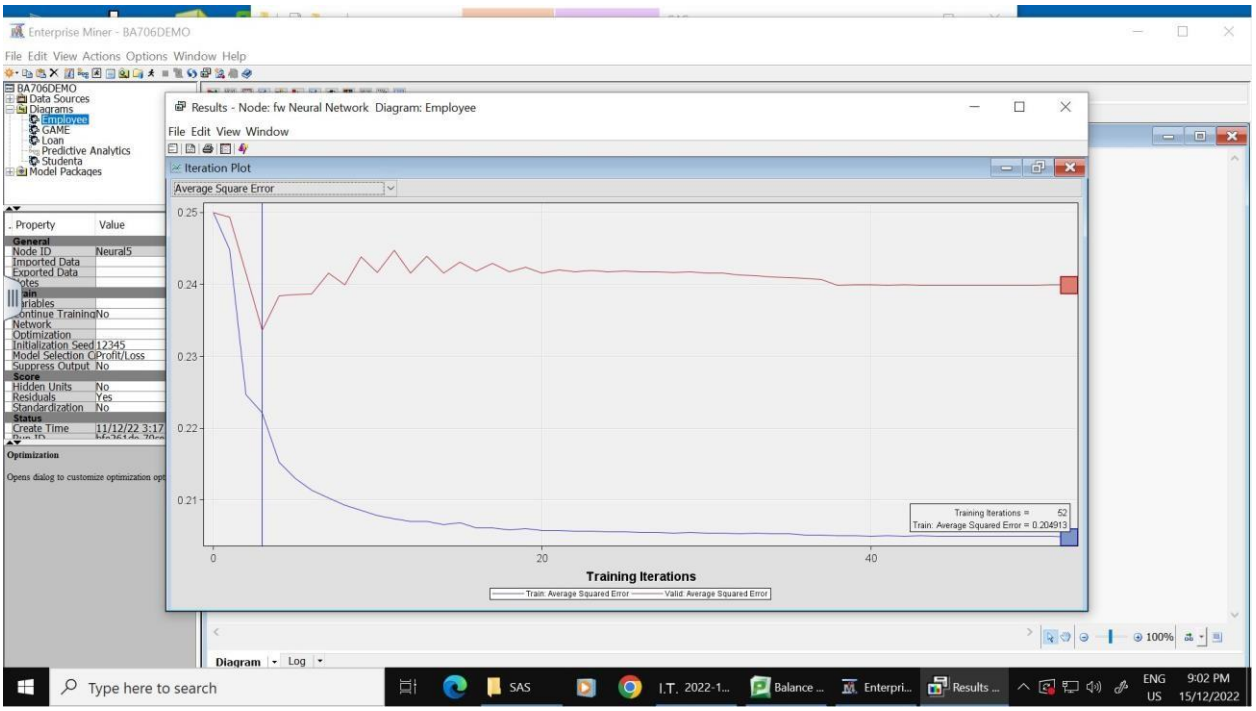

Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Employee
Optimization
Property
Value
Training Technique
Default
Maximum Iterations
100
Maximum Time
10 Minutes
Nonlinear Options
Use Defaults
Yes
Absolute
-1.34078E154
Absolute Function
0
Absolute Function Times
1
Absolute Gradient
1.0E-5
Absolute Gradient Times
1
Absolute Parameter
1.0E-8
Absolute Parameter Times
1
Training Technique
Specifies the training technique. The following are valid selections: DEFAULT (the default depends on the number of weights that are applied during execution), Trust-Region, Levenberg-Marquardt, Quasi-Newton, Conjugate Gradient, DBLDOG, BackProp, RPROP (uses
OK
Cancel
File Import
Data Partition
Max Decision Tree
Max Decision Tree 3 maxB
Classification
full Regression
forward reg
fix NN6
fix NN5
fix NN4
fix Neural Network
fix NN2
NN7
Model Comparison
StatExplore (2)
Neural Network cap...
Diagram
Log
Type here to search
SAS
I.T. 2022-12-0...
Balance for ...
Enterprise ...
ENG
US
7:42 PM
16/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Employee
Network
Property
Value
Architecture
Multilayer Perceptron
Direct Connection
No
Number of Hidden Units
3
Randomization Distribution
Normal
Randomization Center
0.0
Randomization Scale
0.1
Input Standardization
Standard Deviation
Hidden Layer Combination Function
Default
Hidden Layer Activation Function
Default
Hidden Bias
Yes
Target Layer Combination Function
Default
Target Layer Activation Function
Default
Architecture
Specifies which network architecture is used in constructing the network. The following are valid selections: generalized linear model, multilayer perceptron, ordinary radial basis function with equal widths, ordinary radial basis function with unequal widths, normalized radial basis function with equal heights, normalized radial basis function with equal volumes, normalized radial basis function with equal widths, normalized radial basis function with equal widths and heights, normalized radial basis function with unequal widths and heights and a User specified network.
OK
Cancel
Diagram
Log
Type here to search
SAS
I.T. 2022-12-0...
Balance for ...
Enterprise ...
ENG US
6:17 PM
12/12/2022


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
Results - Node: fw Neural Network Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Depth
TRAIN
VALIDATE
Fit Statistics
Target
Target Label
Fit Statistics
Statistics Label
Train
Validation
Test
event DFT Total De... 564
event DFE Degrees ... 503
event DFM Model De... 61
event NW Number o... 61
event AIC Akaike's I... 835.9134 1100.352
event SBC Schwarz'... 1100.352
event ASE Average ... 0.222123 0.23363
event MAX Maximum... 0.785835 0.96102
event DIV Divisor fo... 1128 1130
event NOBS Sum of Fr... 564 565
event RASE Root Ave... 0.471299 0.483353
event SSE Sum of S... 250.5546 264.0017
event SUMW Sum of C... 1128 1130
event FPE Final Pre... 0.275998
event MSE Mean Sq... 0.24906 0.23363
Iteration Plot
Average Square Error
Training Iterations
Train: Average Squared Error
Valid: Average Squared Error
Output
User: 301259629
Date: December 15, 2022
Time: 21:00:51
* Training Output
Variable Summary
Measurement Level
Frequency Count
Role
Diagram
Log
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG US
9:01 PM
15/12/2022

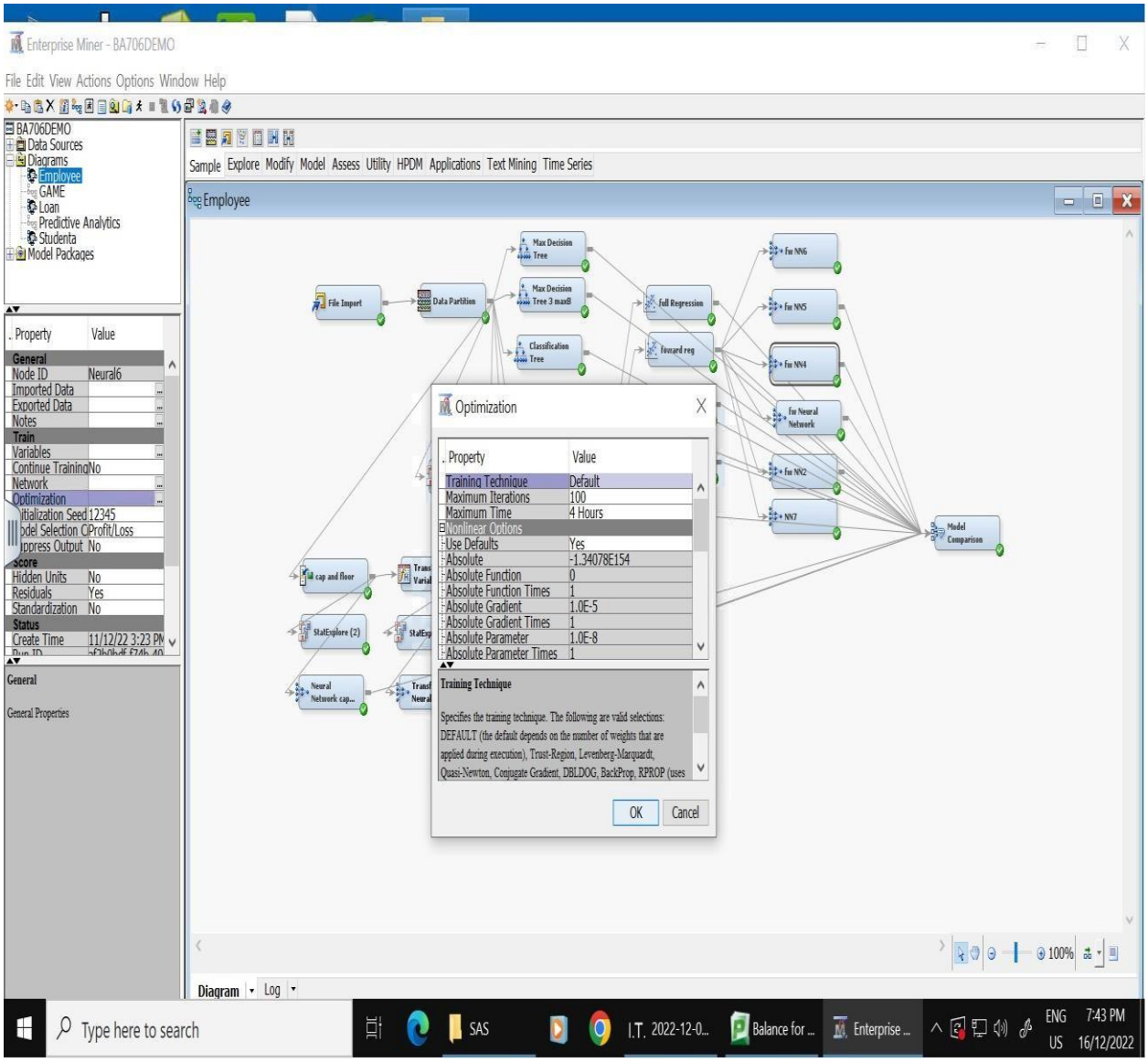


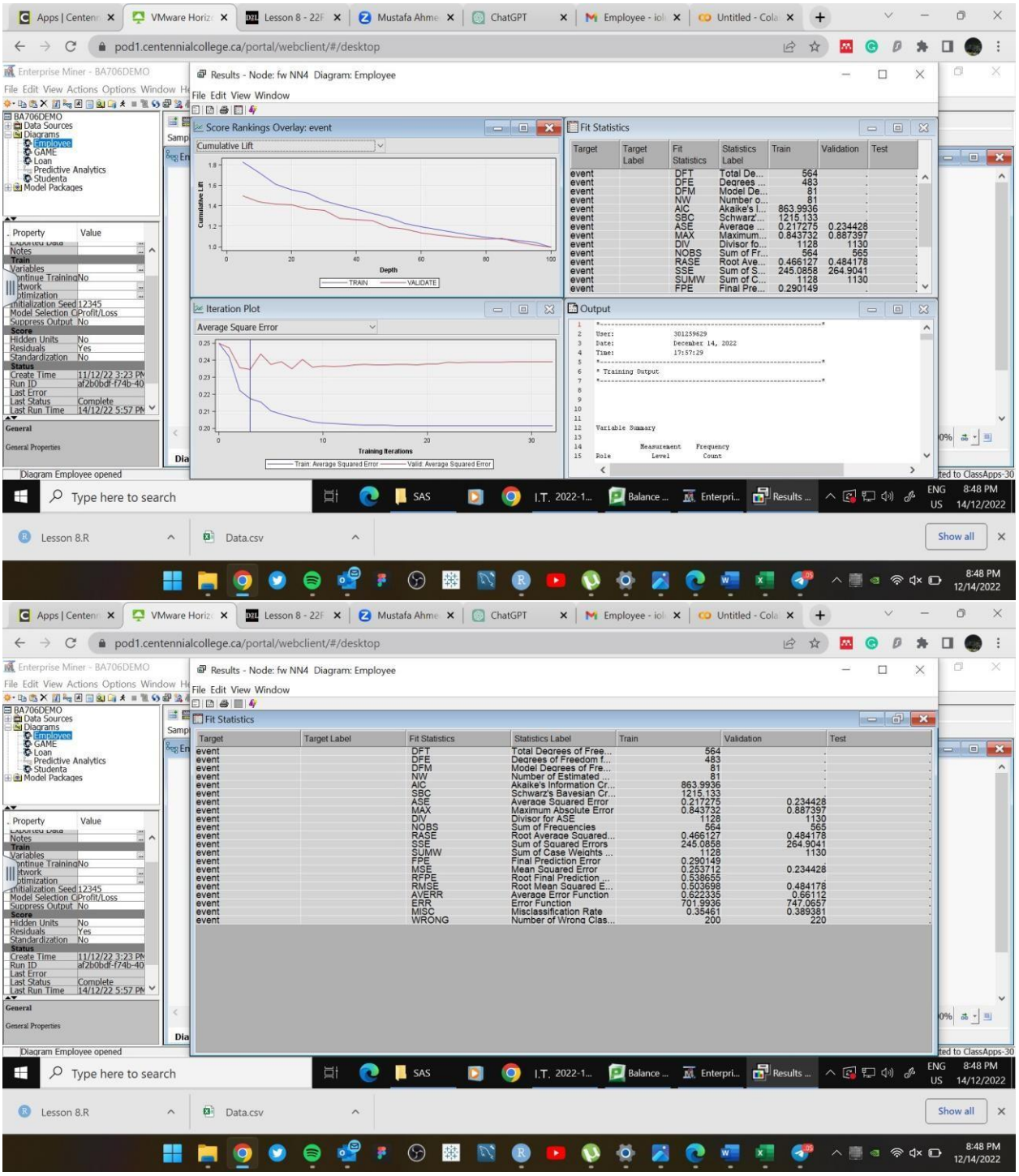
Here, we see that the average squared error of the training and validation data sets start off in the same direction of improvement till iteration 3 where the validation ASE starts to increase as a sign of overfitting. this occurs until the point of convergence at iteration 52.



NEURAL NETWORK WITH 4 HIDDEN UNITS

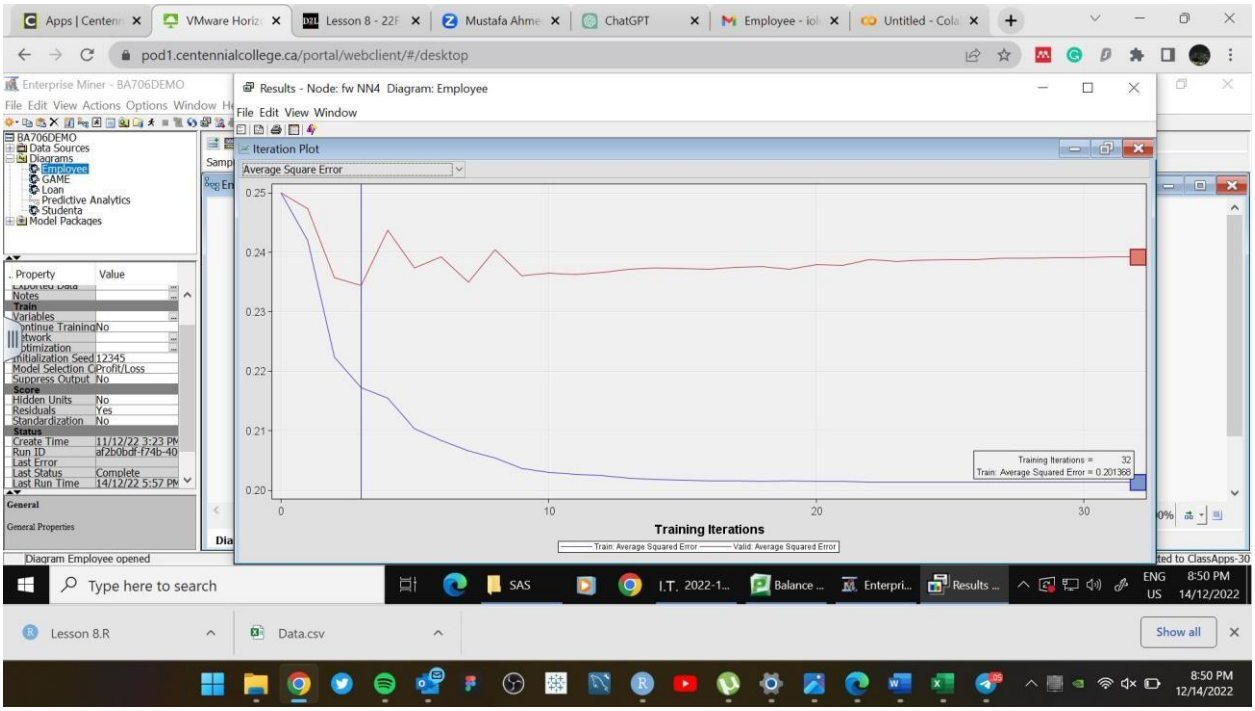
We continued to check for the best neural network model by increasing the number of hidden units to 4 as we noticed 3 hidden units was an improvement when compared to 2 hidden units. The result from the four hidden units neural network was even worse than that os the two hidden units with an ASE of 0.234428 .





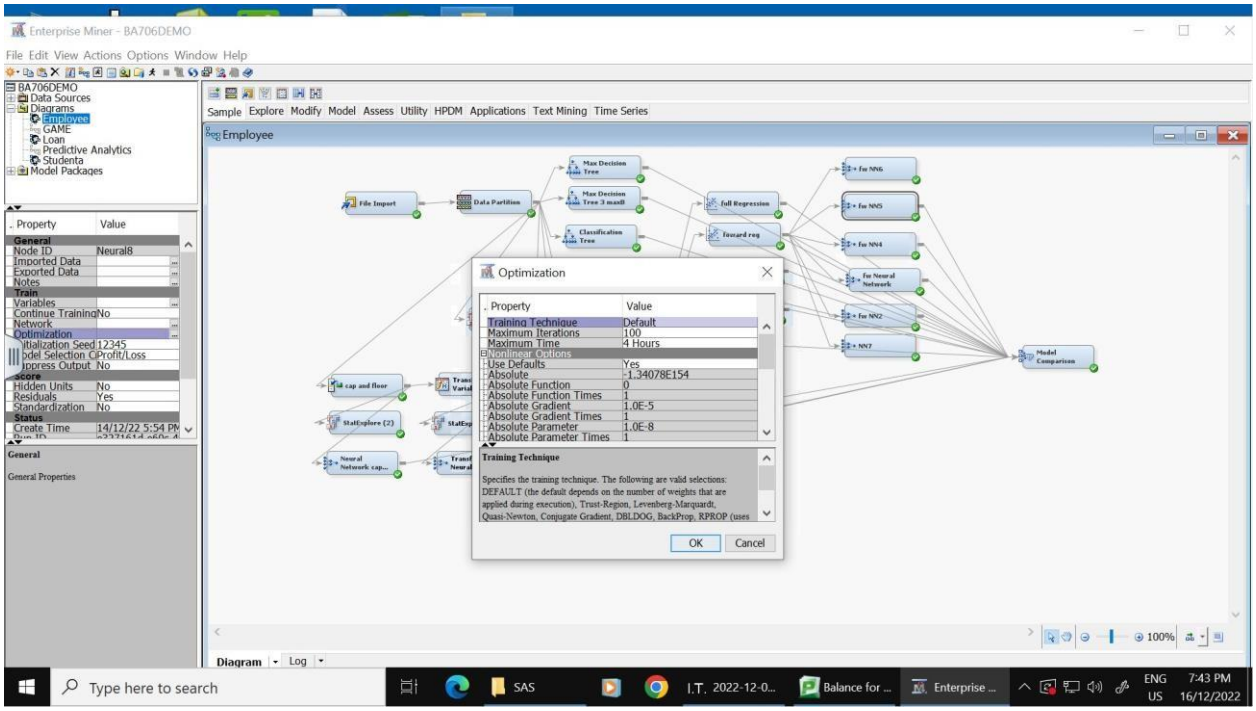
Target	Target Label	Fit Statistics	Statistics Label	Train	Validation	Test
event		DFT	Total Degrees of Free...	564		
event		DFE	Degrees of Freedom f...	483		
event		DFM	Model Degrees of Fre...	81		
event		NW	Number of Estimated ...	81		
event		AIC	Akaike's Information Cr...	863.9936		
event		SBC	Schwarz's Bayesian Cr...	1215.133		
event		ASE	Average Squared Error	0.217275	0.234428	
event		MAX	Maximum Absolute Error	0.843732	0.887397	
event		DIV	Divisor for ASE	1128	1130	
event		NOBS	Sum of Frequencies	564	565	
event		RASE	Root Average Squared...	0.466127	0.484178	
event		SSE	Sum of Squared Errors	245.0858	264.9041	
event		SUMW	Sum of Case Weights ...	1128	1130	
event		FPE	Final Prediction Error	0.290149		
event		MSE	Mean Squared Error	0.253712	0.234428	
event		RFPE	Root Final Prediction ...	0.538655		
event		RMSE	Root Mean Squared E...	0.503698	0.484178	
event		AVERR	Average Error Function	0.622335	0.66112	
event		ERR	Error Function	701.9936	747.0657	
event		MISC	Misclassification Rate	0.35461	0.389381	
event		WRONG	Number of Wrong Clas...	200	220	

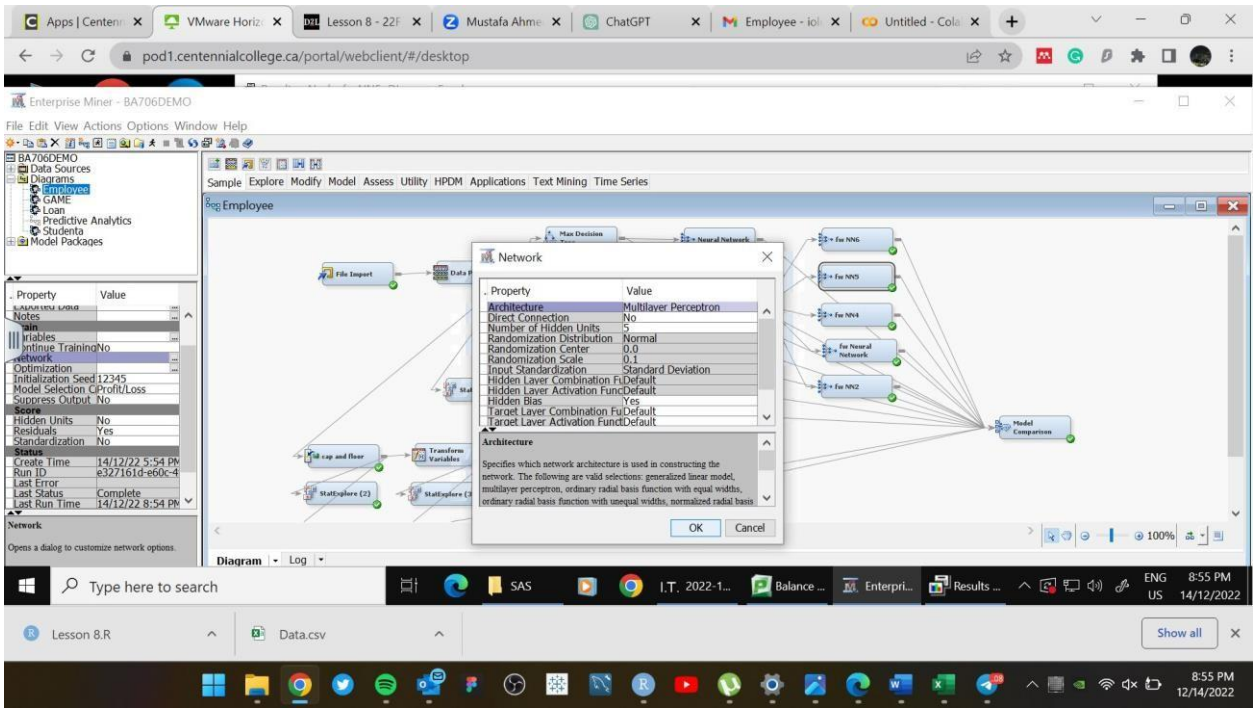
Here, we see that the average squared error of the training and validation data sets start off in the same direction of improvement and then the validation ASE starts to increase as a sign of overfitting. This occurs until the point of convergence at iteration 32.

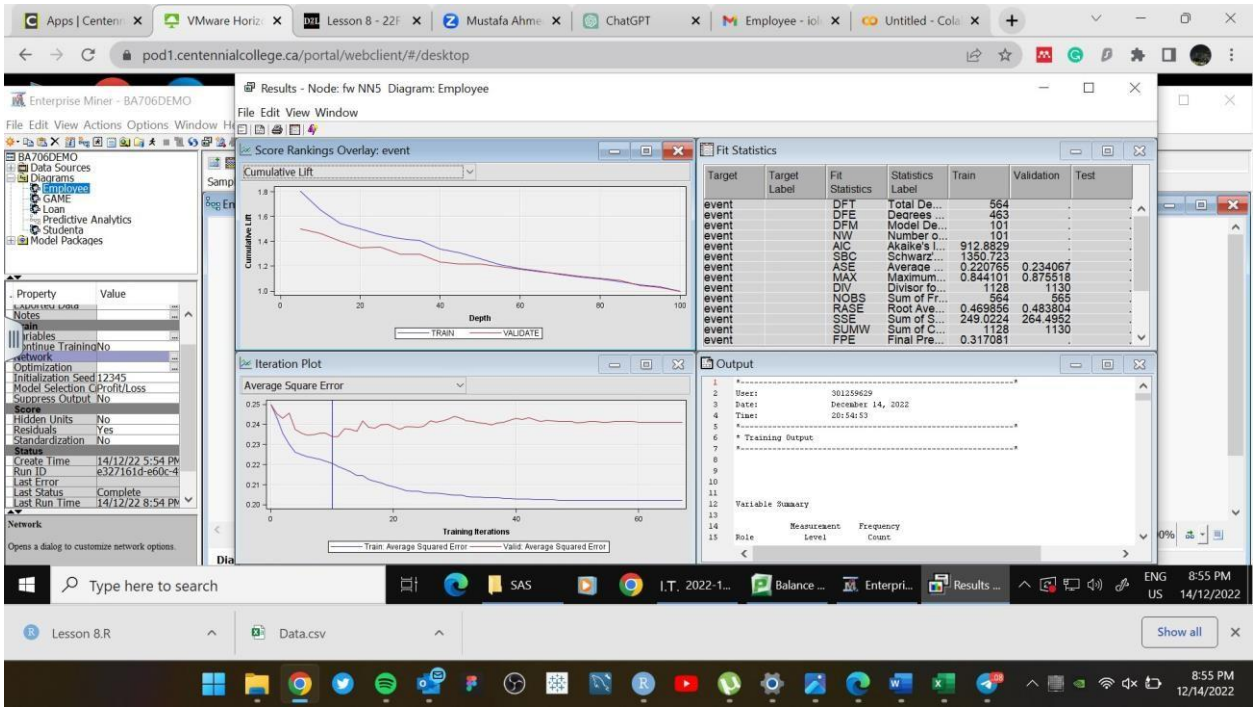


NEURAL NETWORK WITH 5 HIDDEN UNITS

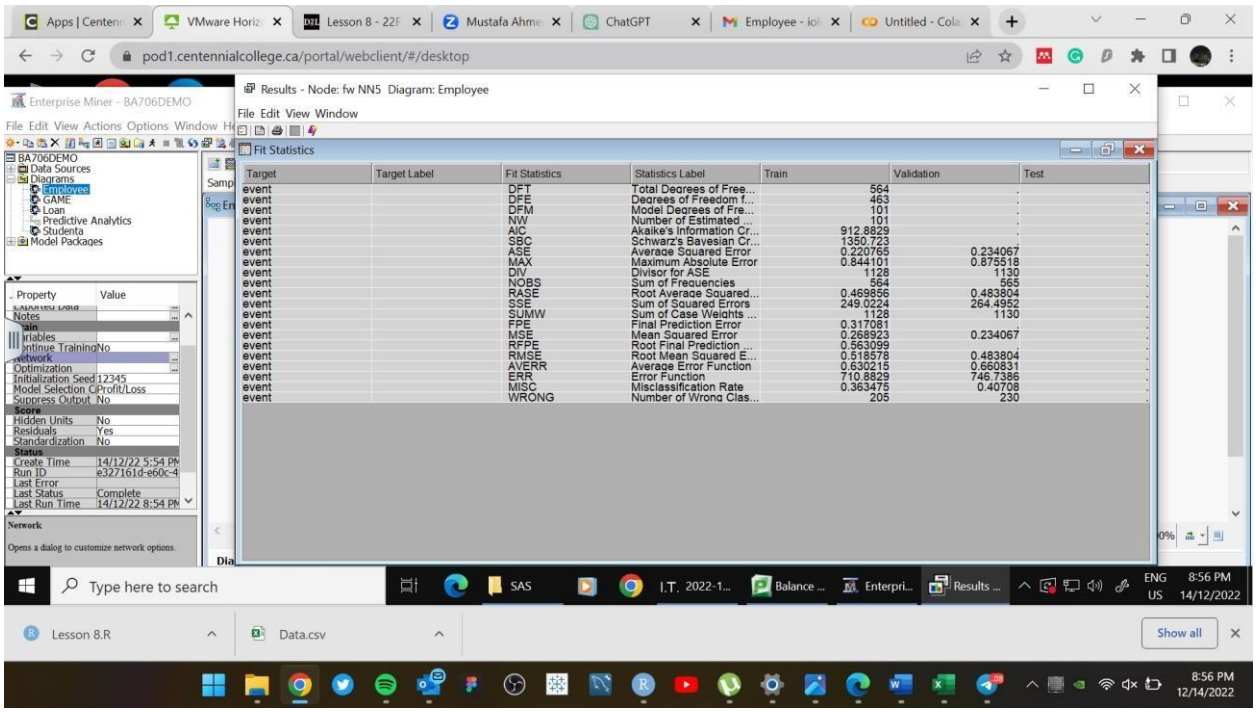
We further increased the number of hidden units to 5 and the outcome ASE of 0.234067 was an improvement on the two hidden unit neural network but not as good as the three hidden unit neural network. This proves no further need to run additional hidden units as the aim is to find the leat complex model with the best result.


Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Employee
Optimization
Property
Value
Training Technique
Default
Maximum Iterations
100
Maximum Time
4 Hours
Nonlinear Options
Use Defaults
Yes
Absolute
-1.34078E154
Absolute Function
0
Absolute Function Times
1
Absolute Gradient
1.0E-5
Absolute Gradient Times
1
Absolute Parameter
1.0E-8
Absolute Parameter Times
1
Training Technique
Specifies the training technique. The following are valid selections: DEFAULT (the default depends on the number of weights that are applied during execution), Trust-Region, Levenberg-Marquardt, Quasi-Newton, Conjugate Gradient, DBLDOG, BackProp, RPROP (uses
OK
Cancel
Diagram
Log
Type here to search
SAS
I.T. 2022-12-0...
Balance for ...
Enterprise ...
ENG
US
7:43 PM
16/12/2022


Apps | Centenn
VMware Horiz
Lesson 8 - 22F
Mustafa Ahme
ChatGPT
Employee - iol
Untitled - Cola
pod1.centennialcollege.ca/portal/webclient/#/desktop
Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Sample Explore Modify Model Assess Utility HPDM Applications Text Mining Time Series
Employee
Network
Property
Value
Architecture
Multilayer Perceptron
Direct Connection
No
Number of Hidden Units
5
Randomization Distribution
Normal
Randomization Center
0.0
Randomization Scale
0.1
Input Standardization
Standard Deviation
Hidden Layer Combination Fu
Default
Hidden Layer Activation Func
Default
Hidden Bias
Yes
Target Layer Combination Fu
Default
Target Layer Activation Funct
Default
Architecture
Specifies which network architecture is used in constructing the network. The following are valid selections: generalized linear model, multilayer perceptron, ordinary radial basis function with equal widths, ordinary radial basis function with unequal widths, normalized radial basis
OK
Cancel
Diagram
Log
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG
US
8:55 PM
14/12/2022
Lesson 8.R
Data.csv
Show all
8:55 PM
12/14/2022

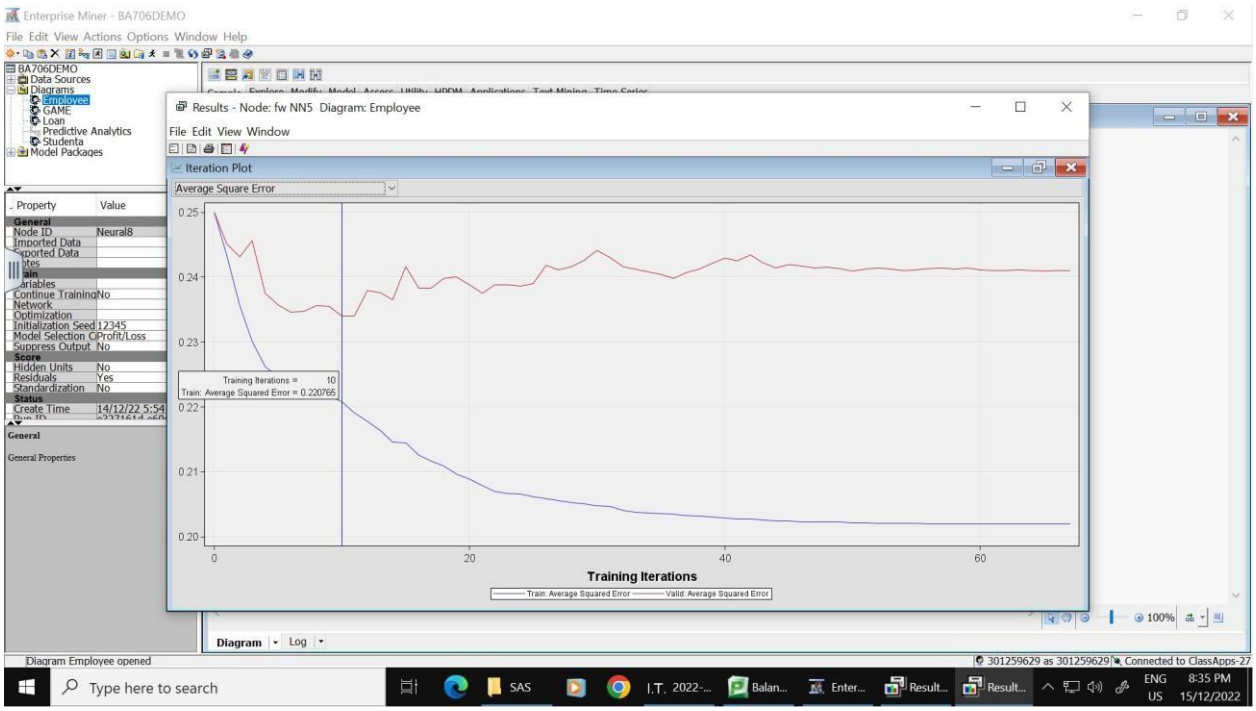


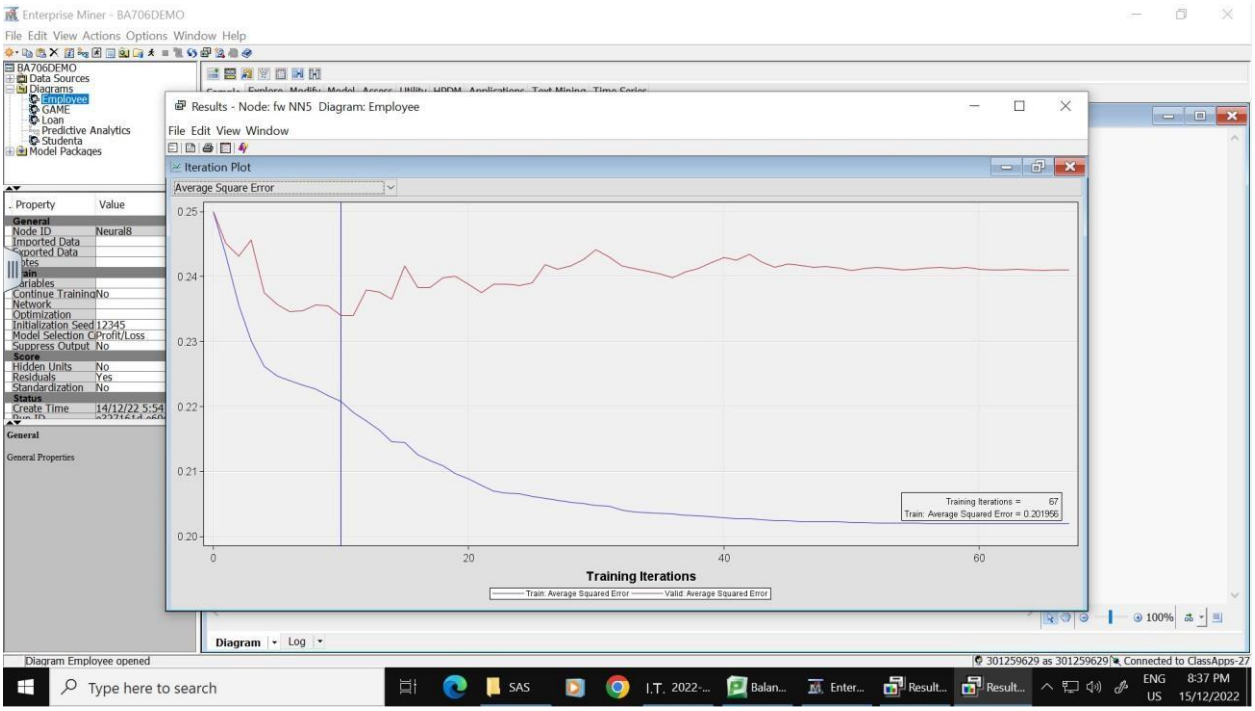
Target	Target Label	Fit Statistics	Statistics Label	Train	Validation	Test
event		DFT	Total De...	564	.	.
event		DFE	Degrees ...	463	.	.
event		DFM	Model De...	101	.	.
event		NW	Number o...	101	.	.
event		AIC	Akaike's I...	912.8829	.	.
event		SBC	Schwarz'...	1350.723	.	.
event		ASE	Average ...	0.220765	0.234067	.
event		MAX	Maximum...	0.844101	0.875518	.
event		DIV	Divisor fo...	1128	1130	.
event		NOBS	Sum of Fr...	564	565	.
event		RASE	Root Ave...	0.469856	0.483804	.
event		SSE	Sum of S...	249.0224	264.4952	.
event		SUMW	Sum of C...	1128	1130	.
event		FPE	Final Pre...	0.317081	.	.



Target	Target Label	Fit Statistics	Statistics Label	Train	Validation	Test
event		DFT	Total Degrees of Free...	564	.	.
event		DFE	Degrees of Freedom f...	463	.	.
event		DFM	Model Degrees of Fre...	101	.	.
event		NW	Number of Estimated ...	101	.	.
event		AIC	Akaike's Information Cr...	912.8829	.	.
event		SBC	Schwarz's Bayesian Cr...	1350.723	.	.
event		ASE	Average Squared Error	0.220765	0.234067	.
event		MAX	Maximum Absolute Error	0.844101	0.875518	.
event		DIV	Divisor for ASE	1128	1130	.
event		NOBS	Sum of Frequencies	564	565	.
event		RASE	Root Average Squared...	0.469856	0.483804	.
event		SSE	Sum of Squared Errors	249.0224	264.4952	.
event		SUMW	Sum of Case Weights ...	1128	1130	.
event		FPE	Final Prediction Error	0.317081	.	.
event		MSE	Mean Squared Error	0.268923	0.234067	.
event		RFPE	Root Final Prediction ...	0.563099	.	.
event		RMSE	Root Mean Squared E...	0.518578	0.483804	.
event		AVERR	Average Error Function	0.630215	0.660831	.
event		ERR	Error Function	710.8829	746.7386	.
event		MISC	Misclassification Rate	0.363475	0.40708	.
event		WRONG	Number of Wrong Clas...	205	230	.

Here, we see that the average squared error of the training and validation data sets start off in the same direction of improvement till iteration 10 where the validation ASE starts to increase as a sign of overfitting. This occurs until the point of convergence at iteration 67.

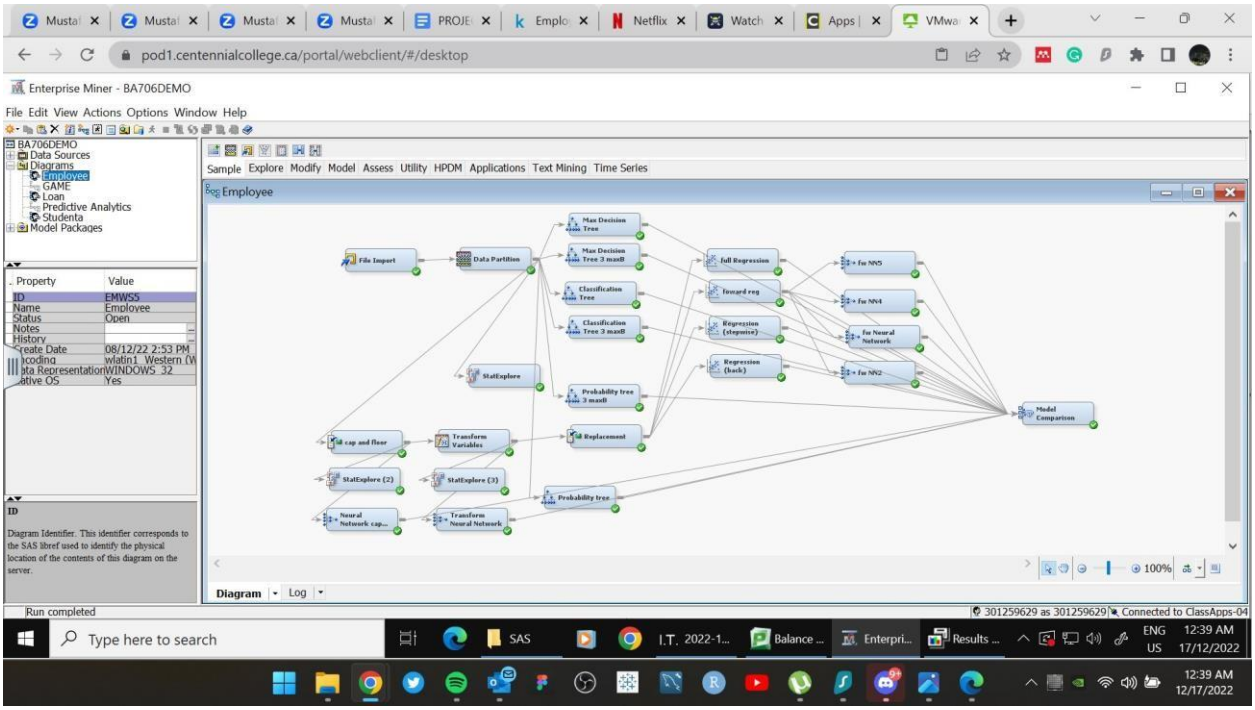



Enterprise Miner - BA706DEMO
File Edit View Actions Options Window Help
BA706DEMO
Data Sources
Diagrams
Employee
GAME
Loan
Predictive Analytics
Studenta
Model Packages
Property
Value
Node ID
Neural8
Imported Data
Continue Training
No
Network
Optimization
Initialization Seed
12345
Model Selection CP
Profit/Loss
Suppress Output
No
Hidden Units
No
Residuals
Yes
Standardization
No
Create Time
14/12/22 5:54
General
General Properties
Results - Node: fw NN5 Diagram: Employee
File Edit View Window
Iteration Plot
Average Square Error
0.25
0.24
0.23
0.22
0.21
0.20
0
20
40
60
Training Iterations
Training Iterations = 67
Train: Average Squared Error = 0.201956
Train: Average Squared Error
Valid: Average Squared Error
Diagram
Log
100%
Diagram Employee opened
301259629 as 301259629
Connected to ClassApps-27
Type here to search
SAS
I.T. 2022-...
Balan...
Enter...
Result...
Result...
ENG
US
8:37 PM
15/12/2022

ASSESSMENT

MODEL COMPARISON

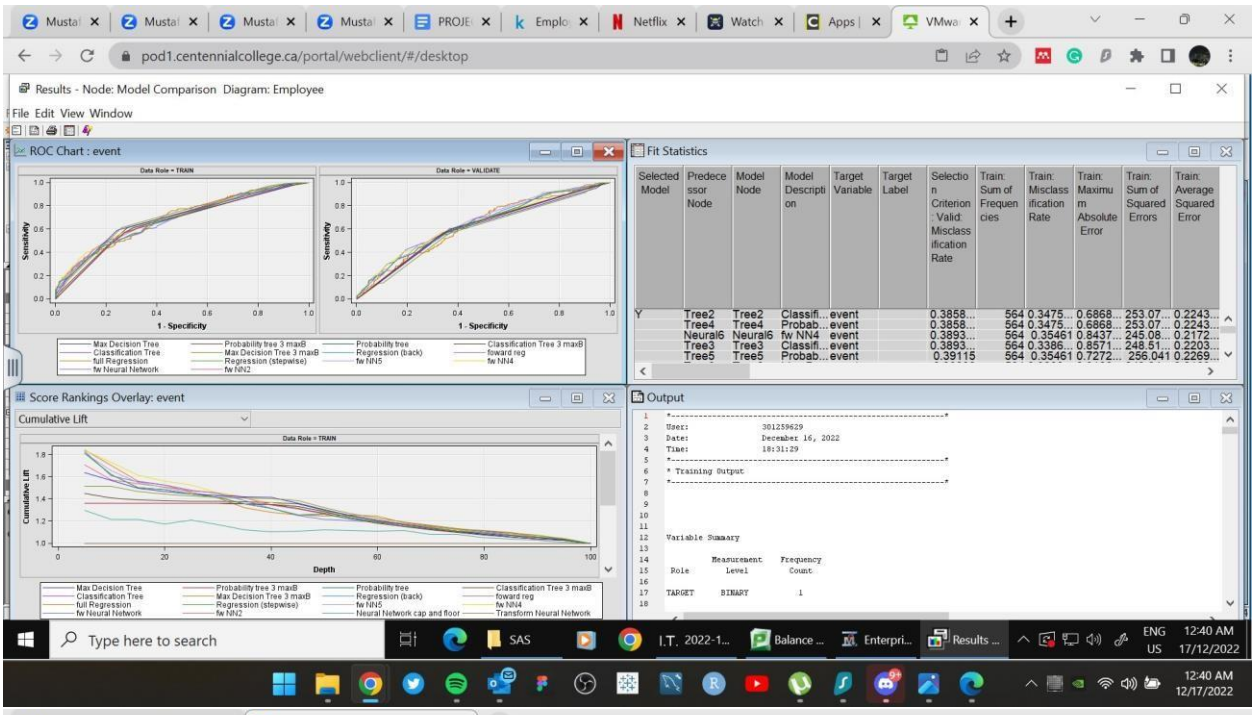
Finally, a model comparison node was introduced to the diagram workspace to which the different decision trees, regressions, and neural network models were connected. The results show a comparison of all models using several statistical tests. The below shows the final diagram of all the models we tested in this project:

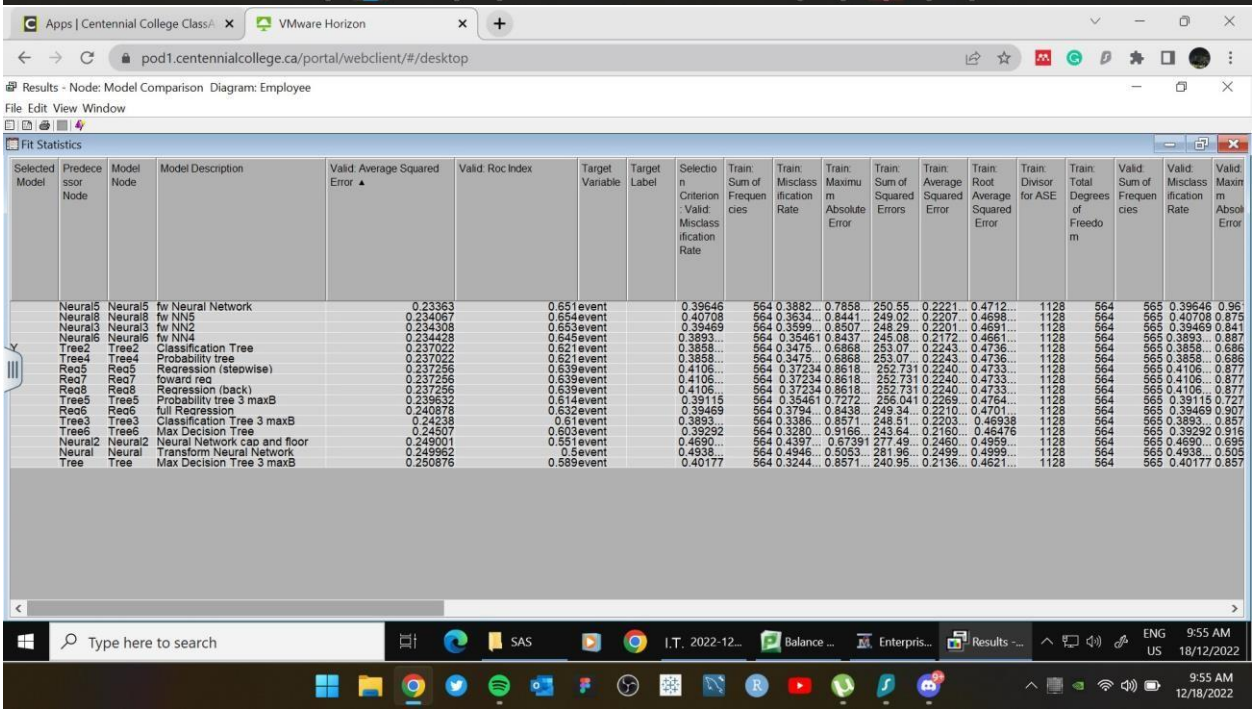


As stated earlier, we will be selecting the most fit model using the Average squared error. Below shows the summary of all models the Average squared error and ROC index. Using the ROC index as a selection criterion, the best model would be the Neural Network with 5 hidden units and ROC index of 0.654. However, our chosen method of selection is the Average squared error hence the Neural Network with 3 hidden units is the best model.

Model Type	Average Squared Error	ROC
Neural Network 3 hidden units	**0.233630**	0.651
Neural Network 5 hidden units	0.234067	0.654

Network 2 hidden units	0.234308	Neural	0.653
Network 4 hidden units	0.234428	Neural	0.645
Classification Tree 2 branch	0.237022		0.621
Probability Tree 2 branch	0.237022		0.621
Regression Stepwise	0.237256		0.639
Regression Forward	0.237256		0.639
Regression Backward	0.237256		0.639
Probability Tree 3 branch	0.239632		0.614
Regression Full	0.240878		0.632
Classification Tree 3 branch	0.242380		0.610
Maximal Decision Tree	0.245070		0.603





Selected Model	Predecessor Node	Model Node	Model Description	Valid: Average Squared Error ▲	Valid: Roc Index	Target Variable	Target Label	Selection Criterion: Valid: Misclassification Rate	Train: Sum of Frequencies	Train: Misclassification Rate	Train: Maximum Absolute Error	Train: Sum of Squared Errors	Train: Average Squared Error	Train: Root Average Squared Error	Train: Divisor for ASE	Train: Total Degrees of Freedom	Valid: Sum of Frequencies	Valid: Misclassification Rate	Valid: Maximum Absolute Error
	Neural5	Neural5	fw Neural Network	0.23363	0.651	event		0.39646	564	0.3882...	0.7858...	250.55...	0.2221...	0.4712...	1128	564	565	0.39646	0.96
	Neural8	Neural8	fw NN5	0.234067	0.654	event		0.40708	564	0.3634...	0.8441...	249.02...	0.2207...	0.4698...	1128	564	565	0.40708	0.875
	Neural3	Neural3	fw NN2	0.234308	0.653	event		0.39469	564	0.3599...	0.8507...	248.29...	0.2201...	0.4691...	1128	564	565	0.39469	0.841
	Neural6	Neural6	fw NN4	0.234428	0.645	event		0.3893...	564	0.35461	0.8437...	245.08...	0.2172...	0.4661...	1128	564	565	0.3893...	0.887
	Tree2	Tree2	Classification Tree	0.237022	0.621	event		0.3858...	564	0.3475...	0.6868...	253.07...	0.2243...	0.4736...	1128	564	565	0.3858...	0.686
	Tree4	Tree4	Probability tree	0.237022	0.621	event		0.3858...	564	0.3475...	0.6868...	253.07...	0.2243...	0.4736...	1128	564	565	0.3858...	0.686
	Reg5	Reg5	Regression (stepwise)	0.237256	0.639	event		0.4106...	564	0.37234	0.8618...	252.731	0.2240...	0.4733...	1128	564	565	0.4106...	0.877
	Reg7	Reg7	foward reg	0.237256	0.639	event		0.4106...	564	0.37234	0.8618...	252.731	0.2240...	0.4733...	1128	564	565	0.4106...	0.877
	Reg8	Reg8	Regression (back)	0.237256	0.639	event		0.4106...	564	0.37234	0.8618...	252.731	0.2240...	0.4733...	1128	564	565	0.4106...	0.877
	Tree5	Tree5	Probability tree 3 maxB	0.239632	0.614	event		0.39115	564	0.35461	0.7272...	256.041	0.2269...	0.4764...	1128	564	565	0.39115	0.727
	Reg6	Reg6	full Regression	0.240878	0.632	event		0.39469	564	0.3794...	0.8438...	249.34...	0.2210...	0.4701...	1128	564	565	0.39469	0.907
	Tree3	Tree3	Classification Tree 3 maxB	0.24238	0.61	event		0.3893...	564	0.3386...	0.8571...	248.51...	0.2203...	0.46938	1128	564	565	0.3893...	0.857
	Tree6	Tree6	Max Decision Tree	0.24507	0.603	event		0.39292	564	0.3280...	0.9166...	243.64...	0.2160...	0.46476	1128	564	565	0.39292	0.916
	Neural2	Neural2	Neural Network cap and floor	0.249001	0.551	event		0.4690...	564	0.4397...	0.67391	277.49...	0.2460...	0.4959...	1128	564	565	0.4690...	0.695
	Neural	Neural	Transform Neural Network	0.249962	0.5	event		0.4938...	564	0.4946...	0.5053...	281.96...	0.2499...	0.4999...	1128	564	565	0.4938...	0.505
	Tree	Tree	Max Decision Tree 3 maxB	0.250876	0.589	event		0.40177	564	0.3244...	0.8571...	240.95...	0.2136...	0.4621...	1128	564	565	0.40177	0.857


pod1.centennialcollege.ca/portal/webclient/#/desktop
Results - Node: Model Comparison Diagram: Employee
File Edit View Window
ROC Chart : event
Data Role = VALIDATE
Sensitivity
1 - Specificity
Max Decision Tree
toward reg
Probability tree 3 maxB
full Regression
Probability tree
Regression (stepwise)
Classification Tree 3 maxB
fw NN5
Classification Tree
fw NN4
Max Decision Tree 3 maxB
fw Neural Network
Regression (back)
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG
US
12:42 AM
17/12/2022
12:42 AM
12/17/2022


pod1.centennialcollege.ca/portal/webclient/#/desktop
Results - Node: Model Comparison Diagram: Employee
File Edit View Window
Score Rankings Overlay: event
Cumulative Lift
Data Role = VALIDATE
Cumulative Lift
Depth
Max Decision Tree
full Regression
Probability tree 3 maxB
Regression (stepwise)
Probability tree
fw NN5
Classification Tree 3 maxB
fw NN4
Classification Tree
fw Neural Network
Max Decision Tree 3 maxB
fw NN2
Regression (back)
Neural Network cap and floor
toward reg
Transform Neural Network
Type here to search
SAS
I.T. 2022-1...
Balance ...
Enterpri...
Results ...
ENG
US
12:42 AM
17/12/2022
12:42 AM
12/17/2022

CONCLUSION

The best model is the Neural Network with 3 hidden units which has a validation Average Square Error of 0.23363. This neural network model was derived from attaching a neural network node to the forward regression model which had the best ASE of 0.237256. However, because of the complexity of how the Neural network arrives at its result, we are unable to explain in detail the next steps to take to reduce attrition in the different industries using this model. For this reason, we will be using the next best model which is easy to interpret to make suggestions for improvement. From the comparison table, the next best models which are not neural network models are the classification tree and probability tree with two branches. They both have a Validation Average Square Error of 0.237022. Therefore, we will make our recommendations based on these trees. We will also use the forward regression model results to support our recommendations.

For all the trees used in this project, the first split occurred in the industry variable. This variable had the highest log worth and was considered the most important variable by the decision trees and interestingly by most of the regression models too. Other variables considered by the trees are Profession, Stag (duration of experience), and Way (means of transportation to the workplace).

The trees show that 60% of employees in Banks, Consult and State industries are likely to quit their jobs with 62.89% of these employees requiring a vehicle to get to work. Employees who walk to the office (most likely because they stay in close proximity) are less likely to quit their jobs. 43.99% of the employees in the power generation, and retail industries are likely to quit with a higher percentage than those in the commercial, sales, and finance professions.

The forward regression model used the transport industry as a means of comparison for all other industries. It appears to be the most stable industry that is able to retain its employees after the IT industry with the least likelihood of attrition. Employees in HR and IT profession when compared with sales are also less likely to quit their jobs.

Below are the insights obtained from the selected models and our recommendations:

1. **Banks, Consult, and State Industry:** With 60% of employees leaving their jobs, a deep dive could show specific reasons for attrition. From the forward regression model, those in

banks, consult, and state are 4.6, 4.,4 and 3.1 times respectively more likely to quit their jobs when compared with those in the transport industry. There might also be a need to study the transport industry to see why it seems more stable and able to retain its employees.

We suggest a drive for work-life balance is implemented in these industries. Incentives should be given for working longer than usual work hours, compensation given for achieving goals far and beyond expectations, and recognition for assignments well executed. A program for continued benefits after retirement should also be introduced. All these might be useful in encouraging professionals within these industries to stay on the job for a longer period or till retirement.

2. **Employees who come to work by bus or car:** Proximity to the office location also appears to be an important factor from both the tree models and regression models. People who have to get to work with a vehicle are 2.5 times more likely to quit their jobs. We advise that attention is given to how employees get to work. A transportation initiative can be introduced whereby employees have a choice of joining a staff bus that does a pick-up and drop-off for staff who stay a distance from the workplace. This will reduce the stress of driving to work or joining the public transportation system on a daily basis. In addition, the employees can be given the option of working remotely on some days in the week. This option has become a widely accepted work arrangement in the past two years which has improved the work-life balance of employees.

3. **Commercial, Sales and Finance Profession:** From the regression models, we see that employees in all other professions including sales are more likely to quit their jobs when compared with HR and IT professionals. We would say carrying out an investigation on the two professions might give an insight as to the reason for their stability. In the mean time, suggestions made for the industries above will also be profitable when applied to the profession variable. In addition, we suggest significance should be attached to attaining specific levels of achievement. This can be an incentive for employees to spend more time on their jobs while they pursue higher levels in their career paths.

REFERENCE

https://www.kaggle.com/datasets/davinwijaya/employee-turnover